SOLARPack 410

Hardware Manual

CONTROL MICROSYSTEMS

SCADA products... for the distance

48 Steacie Drive
Kanata, Ontario
K2K 2A9
Canada

Telephone: 613-591-1943
Facsimile: 613-591-1022
Technical Support: 888-226-6876
888-2CONTROL

SOLARPack 410 - Hardware Manual

©2007 Control Microsystems Inc.
All rights reserved.
Printed in Canada.

Trademarks

TeleSAFE, TelePACE, SmartWIRE, SCADAPack, TeleSAFE Micro16 and TeleBUS are registered trademarks of Control Microsystems Inc.

All other product names are copyright and registered trademarks or trade names of their respective owners.

Table of Contents

1 OVERVIEW 7

2 IMPORTANT SAFETY INFORMATION 8

3 GETTING STARTED 9

3.1 Install Software and User Manuals 9
3.1.1 Install Hardware Manual 9
3.1.2 Install FreeWave Radio Configuration Software 10
3.1.3 Install RealFLO 10
3.2 Mounting Pole Installation 11
3.3 Antenna Installation 11
3.4 Solar Panel Installation 11
3.5 SOLARPack 410 Installation 11
3.6 Remote Sensor Installation 12
3.7 SOLARPack 410 Configuration 12
3.8 RealFLO Programming 12
3.9 Radio Programming 12

4 INSTALLATION 13

4.1 SOLARPack 410 Dimension Drawings 14
4.2 Pole Mount Installation 15
4.3 Wall and Metal Frame Mount Installation 16
4.4 Solar Panel Mounting 18
4.4.1 5W Solar Panel 18
4.4.2 10W Solar Panel 18
4.5 Process Connections 19
4.5.1 Integrated Sensor Version 19
4.5.2 Remote Sensor Version 22

5 WIRING AND CONNECTIONS 26

5.1 Communication Ports 26
5.1.1 COM Port 1 – Sensor Interface Port 26
5.1.2 COM Port 2 – Radio Port and RS232 Port 27

5.1.3 COM Port 3 – Bluetooth Port 27
5.2 Using *Bluetooth* Communications 28
5.2.1 Install SCADAWave 5914 USB Adaptor 28
5.2.2 Install SCADAWave 5914 USB Software Driver 28
5.2.3 Configure Bluetooth Connection 29
5.2.4 Configure Internal Laptop Bluetooth Connection 35
5.2.5 RealFLO Wireless Security Settings 35
5.2.6 Indicator LEDs 36
5.2.7 LED Power Switch 37
5.2.8 Sensor Interface Connector (P7) 37
5.2.9 Security Jumper (J3) 37
5.2.10 Bluetooth Factory Default Reset Jumper (J8) 38
5.2.11 Factory Test Points 38
5.2.12 Lithium Battery 38
5.2.13 Reflective Sensor 38
5.2.14 LCD Display 39
5.3 Antenna 39
5.4 Battery Connection 40
5.4.1 Battery Types and Selection 40
5.4.2 Battery Type DIP Switch Settings 41
5.4.3 Battery Wiring 42
5.4.4 Battery Temperature Compensation 42
5.4.5 Charging States 43
5.4.6 Battery Under Voltage Lockout 44
5.4.7 Using an External Power Supply 44
5.5 Solar Panel Selection 45
5.5.1 Solar Panel Wiring 46
5.6 RTD Wiring 47
5.6.1 Internal Sensor Version 47
5.6.2 Remote Sensor Version 48
5.7 FreeWave 900 MHz Spread Spectrum Transceiver 49
5.7.1 Radio Diagnostics Port 49
5.7.2 Radio Setup Jumper (J1) 50
5.7.3 FreeWave Radio Module Configuration 50
5.8 User Supplied Radios 55
5.8.1 User Supplied Radio Mounting 55
5.8.2 User Supplied Radio Wiring 55

5.9 Counter Input 57
5.9.1 Turbine Meter Counter Input 57
5.9.2 Dry Contact Counter Input 57
5.9.3 Pulse Input RealFLO Configuration 58
5.10 Gas Sampler Output 59
5.10.1 Gas Sampler Output Wiring 60
5.10.2 Gas Sampler Output RealFLO Configuration 61

6 SOLARPACK 410 OPERATION 62
6.1 Operating Modes 62
6.1.1 Run Mode 62
6.1.2 Service Mode 62
6.1.3 Sensor Mode 63
6.1.4 Cold Boot Mode 63
6.2 Power Management 65
6.2.1 Power Management Configuration 65
6.3 Bluetooth Communication 67
6.3.1 Configure Laptop Bluetooth Connection 67

7 SOLARPACK 410 MODBUS DATABASE REGISTERS 69
7.1 Battery Status 69
7.2 Alarm Status 70

8 POWER CONSUMPTION AND AUTONOMY 71

9 MAINTENANCE AND CALIBRATION 72

10 SPECIFICATIONS 73
10.1 General 73
10.2 Controller 73
10.3 Communications 73
10.4 Internal Spread Spectrum Radio Communications 74
10.5 Bluetooth Communications 74
10.6 Pressure Transmitter 75
10.7 Temperature Measurement 76
10.8 Counter Input 76

10.9 Battery Charger 77
10.10 LEDs and Switch 77
10.11 LCD Display 77
10.12 Outputs 77
10.13 Power supplies and power consumption 78
10.14 Approvals and Certifications 78

Index of Figures

Figure 4-1: SOLARPack 410 Dimensions 14
Figure 4-2: SOLARPack 410 Pipe Mounting 15
Figure 4-3: Horizontal Metal Frame Mounting 16
Figure 4-4: Vertical Metal Frame Mounting 17
Figure 4-5: 5W Solar Panel Mounting 18
Figure 4-6: 10W Solar Panel Mounting 18
Figure 4-7: Sensor Interface 21
Figure 4-8: Sensor and sensor interface 21
Figure 4-9: Process-Mounted - Flange Mounting 22
Figure 4-11: Mounting SCADASense 4102 to a Pipe or Surface – Flange Mounting 23
Figure 4-12: PGI-M573 Five Valve Manifold 24
Figure 4-13: PGI-M673 Five Valve Manifold 24
Figure 4-14: Differential Pressure Calibration Connections 25
Figure 4-15: Absolute Pressure Calibration Connections 25
Figure 5-1: SOLARPack 410 Communication Ports 26
Figure 5-2: LED and LED Power Switch Locations 37
Figure 5-3: Security (J3) Location 38
Figure 5-4: *Bluetooth* Factory Default (J8) Location 38
Figure 5-5: Antenna to integrated FreeWave Radio 40
Figure 5-6: Battery DIP Switch 42
Figure 5-7: Battery Wiring 42
Figure 5-8: External Power Supply Operation 45
Figure 5-9: Solar Panel Wiring 46
Figure 5-10: RTD Wiring Examples 47
Figure 5-11: Sensor Interface 47
Figure 5-12: SOLARPack 410 to SCADASense 4102 Wiring 48
Figure 5-13 Radio Diagnostics Modular Jack Connector (P1) Pinout 49
Figure 5-14: Radio Setup Jumper (J1) Location 50
Figure 5-15 COM2 Modular Jack Connector (P2) Pinout 55
Figure 5-16: User supplied radio wiring 56
Figure 5-17: Turbine Meter Input Wiring 57
Figure 5-18: Dry Contact Counter Wiring 58
Figure 5-19: Dry Contact Counter wiring with external pullup resistor 58

Figure 5-20: Gas Sampler Sourcing Output 60
Figure 5-21: Gas Sampler Sinking Output 61

Index of Tables

Table 5-2: SOLARPack 410 LED Operation 36
Table 5-3 Battery Selection.....40
Table 5-4 Battery LCD Indication 44
Table 5-5: Solar Panel Selection.....45
Table 5-6 RS-232 P1 (Radio Diagnostics) Connector 49
Table 5-7 RS-232 P2 (COM2) Connector 55

1 Overview

The SOLARPack 410 is a one-run flow computer with an internal multi-variable sensor, built in display, and communication capability for *walk-up* SCADA. Optional capability allows expansion to include traditional SCADA communication so there is an upgrade path from walk-up to host based SCADA. It does not provide logic programming or C/C++ programming capability for the end user.

SOLARPack 410 features:

- Temperature compensated battery charging with charge and float voltage selectable for different battery types and detection and isolation of defective batteries. Under voltage lockout prevents battery damage as battery approaches end of capacity.
- ARM microcontroller configured for low power operation.
- *Bluetooth* local communications.
- LCD display indication of battery charging state, local *Bluetooth* enable status and user configurable data.
- Choice of optional FreeWave or user supplied radios.
- Counter input configurable for turbine meters or dry contact inputs.
- User configurable gas sampler output.
- Internal multivariable sensor version or remote sensor version supporting the SCADASense 4102 with Remote Sensor firmware.
- 2" pipe, wall, metal framing systems or manifold mounting.
- Corrosion resistant aluminum 3RX enclosure.

2 Important Safety Information

Power, input and output (i/o) wiring must be in accordance with Class I, Division 2 wiring methods Article 501-4 (b) of the National Electrical Code, NFPA 70 for installations in the U.S., or as specified in Section 18-1J2 of the Canadian Electrical Code for installations within Canada and in accordance with the authority having jurisdiction.

WARNING: Battery must be a 12V nominal Gelled electrolyte (gel) or Absorbed Glass Mat (AGM) valve regulated lead acid (VRLA) battery. Battery height, including terminals, must not exceed 7.5 inches. See manual for additional battery types supported.

CAUTION: When installing a battery pay close attention to the polarity of the wiring and battery terminals. Failure to make these connections properly may result in damage to the SOLARPack and the battery.

WARNING: Explosion Hazard. Substitution of components may impair suitability for Class 1, Division 2. Do not disconnect if circuits are live unless the area in known to be non hazardous.

CAUTION: Solar panels must be installed and acceptable for use in Cl. 1, Div. 2 hazardous areas as per the CEC and NEC.

3 Getting Started

This Getting Started Guide provides a brief overview of the installation of the SOLARPack 410 and the optional accessories that may be included.

The installation of the SOLARPack 410 requires the user to install and refer to the ***SOLARPack 410 User Manual***. The installation instructions for the manual are found in the ***Install Hardware Manual*** section of this document.

The installation of the SOLARPack 410 includes:

- Confirm the SOLARPack shipment contents. Ensure any optional equipment that was ordered is included with the shipment. Ensure the hardware manual CD which includes the radio configuration software and optional Vision programming CDs are included.
- Install the hardware manual which contains the complete SOLARPack 410 User and Reference manual that will be used as a reference in this document.
- Install RealFLO which is used to configure the SOLARPack 410 and is required to complete the SOLARPack 410 installation.
- Install FreeWave EZConfig radio programming software if the SOLARPack 410 has the optional FreeWave transceiver.
- Install mounting pole (2") if being used.
- Install antenna on pole – highest point of mounting poll.
- Install solar panel bracket and panel and wiring. As per instructions.
- Install SOLARPack 410.
- Install Batteries.
- Check operation.

These steps are briefly described in the following sections.

3.1 Install Software and User Manuals

The software and user manual installation will depend on the options ordered with the SOLARPack. The software and user manuals needed for the installation and operation of the SOLARPack systems will generally include the following.

Hardware Manual The ***Configuration Software (Including Hardware Manual) CD*** is included with the SOLARPack 410shipment. The complete SOLARPack 410User and Reference manual is included on this CD.

FreeWave EZConfig Software The optional Radio Transceiver the programming software for all versions of available radios is included in the ***Configuration Software (Including Hardware Manual) CD.***

RealFLO Software This software is not included with the SOLARPack 410. This software is ordered separately and is required to configure the SOLARPack 410.

3.1.1 Install Hardware Manual

The complete SOLARPack 410User and Reference manual is included on the ***Configuration Software (Including Hardware Manual) CD*** that was included in your SOLARPack shipment. The

SOLARPack 410 User and Reference manual must be installed as it is referenced in this Getting Started Guide.

To install the SOLARPack 410User and Reference manual on your PC:

- Insert the Configuration Software (Including Hardware Manual) CD into your CD ROM drive. The CD will autorun and display a splash screen with a number of installation options.
- Click on the ***Install Hardware Documentation*** button and follow the Installation Wizard instructions to install the complete hardware manual. Note that the hardware user manuals are in Adobe PDF format. An installation for Adobe Reader is included on the CD if you do not have it installed on your PC.

Once installed the SOLARPack User and Reference manual is opened by selecting: ***Windows Start >> All Programs >> Control Microsystems >> Hardware Manual***. Once the Hardware Manual is opened select SOLARPack 410from the bookmarks at the left of the page.

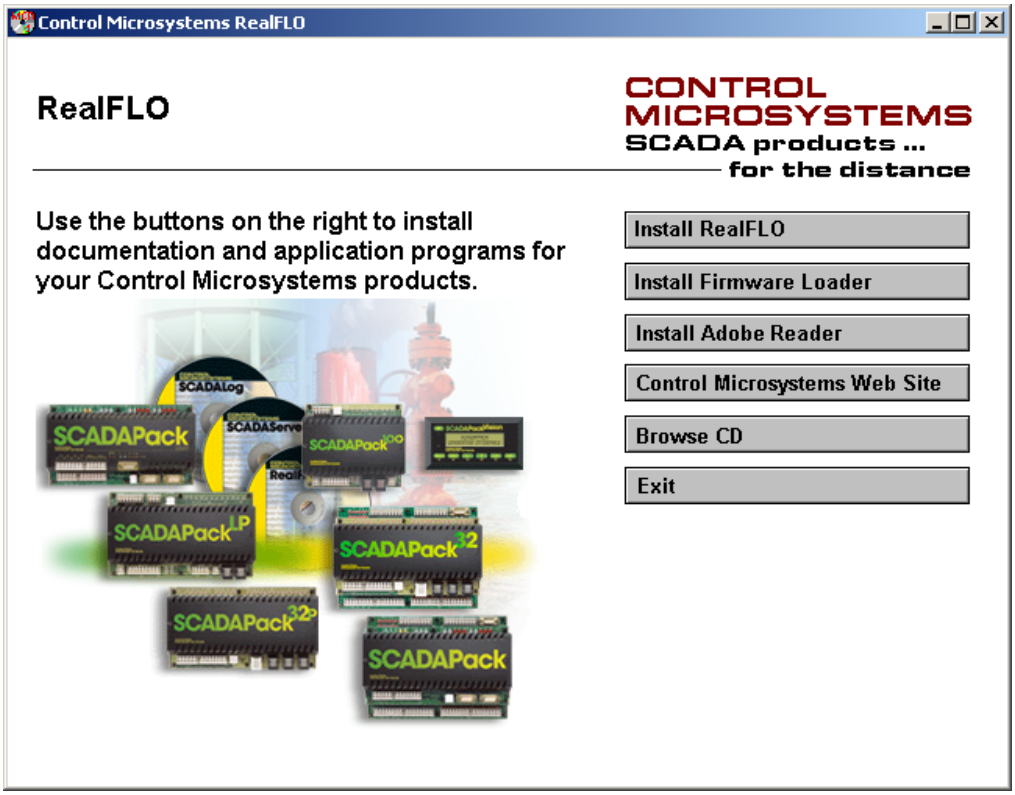
3.1.2 Install FreeWave Radio Configuration Software

When the SOLARPack 410 includes an optional ***FreeWave*** radio transceiver you will need to install the FreeWave EZ Config software.

- Click on the ***Install FreeWave EZ Config*** button and follow the Installation Wizard instructions to install the FreeWave EX Config software.

3.1.3 Install RealFLO

To install RealFLO insert the RealFLO setup disk into CD drive. The CD is autorun and the following menu is displayed.



Note that both RealFLO and Firmware Loader must be installed.

- Select **Install RealFLO** to start the RealFLO install wizard.
- Select **Install Firmware Loader** to start the Firmware Loader install wizard.
- Select **Install Adobe Reader** to install the Adobe Acrobat reader.
- Select **Control Microsystems** Web Site to open the CD version of the website.
- Select **Browse CD** to open Windows Explorer and view the CD contents.
- Select **Exit** to close the RealFLO install menu.

3.2 Mounting Pole Installation

When a 2 inch mounting poll is used for SOLARPack 410installation the poll must be installed in a manner sufficient to support the weight and wind loading of the SOLARPack 410. When determining the mounting poll height consideration must be made for the antenna line of sight when the SOLARPack optional radio is used.

3.3 Antenna Installation

The antenna should be mounted at the highest point on the pole. The optional antenna includes mounting hardware and instructions. Follow the manufacturer's instruction to mount the antenna.

Ensure there is enough coax feed line to reach from the antenna connection to the SOLARPack 410 PolyPhaser connection at the bottom of the SOLARPack 410. Connect the coax feed line to the antenna and seal the connection with weatherproof tape.

3.4 Solar Panel Installation

The solar panel includes mounting hardware and instructions. Follow the manufacturer's instruction to mount the solar panel. The solar panel should be aimed due south. Ensure there is enough solar panel cable to reach from the solar panel to the SOLARPack 410. Tie-wrap or otherwise secure the antenna coax cable and solar panel cable to the pole.

3.5 SOLARPack 410 Installation

Note:	The SOLARPack must be securely mounted in a manner sufficient to support the weight and wind loading. The installation must meet local electrical code requirements.

The SOLARPack 410 is available in two versions; the single enclosure version and the remote sensor version. For both versions mount the SOLARPack housing on the pole at a height which allows the optional Vision display to be easily read, approximately 66 inches from the display to ground level.

- When mounting the SOLARPack 410 to a mounting poll use the U bolt assembly provided to secure the SOLARPack to the mounting poll. Refer to the ***SOLARPack User Manual*** for mounting diagrams.
- When the SOLARPack 410 is mounted to a flat surface secure the SOLARPack 410 using nuts and bolts or lag screws as required.
- Install the needed electrical fittings in bottom of SOLARPack housing to connect the solar panel and SCADASense 4102 remote sensor if used.
- Attach the antenna cable to the SOLARPack PolyPhaser connector and seal the connection with weather-proof tape

3.6 Remote Sensor Installation

Refer to the ***SCADASense 4102 User Manual*** for complete installation instructions. The general procedure for installation of the SCADASense 4102 is as follows:

- Install the SCADASense 4102 and manifold on the meter run.
- Run the conduit or approved cable from the SCADASense 4102 to the SOLARPack housing.
- Connect the conduit or approved cable to the SCADASense 4102 make the necessary connections at the SCADASense 4102.
- Install the RTD in and connect it to the SCADASense 4102.
- Connect the conduit or approved cable to the SOLARPack 410 housing and wire the connections from the SCADASense 4102 to the SOLARPack 410. Refer to the ***SOLARPack 410 User Manual*** for connection diagrams.

3.7 SOLARPack 410 Configuration

- Install the battery, being careful to avoid shorting the positive terminal to the cabinet. Refer to the ***SOLARPack 410 User Manual*** for complete battery installation information. Ensure the battery is installed as shown in SOLARPack 410 User Manual.
- With the battery connected, press the LED Power button and check that the SOLARPack System LED comes on and is green.
- Connect the solar panel to SOLARPack Power Connection terminal P6. See the SOLARPack User Manual for connection details.
- The Battery and Charger Status will now be indicated on the front display.
- Set the SOLARPack 410 DIP switches as required for the charge and float voltage for the battery type.

3.8 RealFLO Programming

The RealFLO Application must be installed on the PC you are using. If it is not installed then insert the RealFLO CD into your CD-ROM drive and run install from the autorun menu.

Open the RealFLO Gas Flow application by clicking the *Windows Start* button then selecting *Programs* then select the *Control Microsystems* group and click *RealFLO.*

3.9 Radio Programming

The optional FreeWave transceiver may be installed in the SOLARPack 410 at time of manufacture. Radios are installed in the factory and cannot be upgraded in the field. Refer to the SOLARPack 410 part number or your order to determine if the FreeWave transceiver is installed.

The optional radio available is the FreeWave FGR09CSU 900 MHz Spread Spectrum Wireless Transceiver.

For detailed operation instructions for the FreeWave transceiver refer to the user manuals installed with the Hardware Manuals CD.

4 Installation

Several factors must be considered when choosing the location to install the SOLARPack 410. These factors include access to the process connections, a suitable structure to support the weight and wind loading of the SOLARPack 410, hazardous locations restrictions as well as access to the solar panel, antenna if required and user access to the display and Bluetooth line of sight.

The SOLARPack 410 with internal sensor is rated for use in Class I, Div. 2 hazardous locations. If Class I, Div. 1 operation is required then the remote sensor version of the SOLARPack 410 can be used. The SCADASense 4102 with Remote Sensor firmware is installed in the Div. 1 area and the SOLARPack 410 enclosure is installed in the Div. 2 area.

Class I *Bluetooth* allows up to 100m (330 feet) line of sight communications. This is under ideal conditions is affected by the power, sensitivity and orientation of the host *Bluetooth* as well as the orientation and obstructions in the SOLARPack 410 installation.

The SOLARPack 410 with battery installed can get very heavy. It is recommended that the battery be removed during installation. This will also reduce the risk of accidentally shorting the battery terminals.

4.1 SOLARPack 410 Dimension Drawings

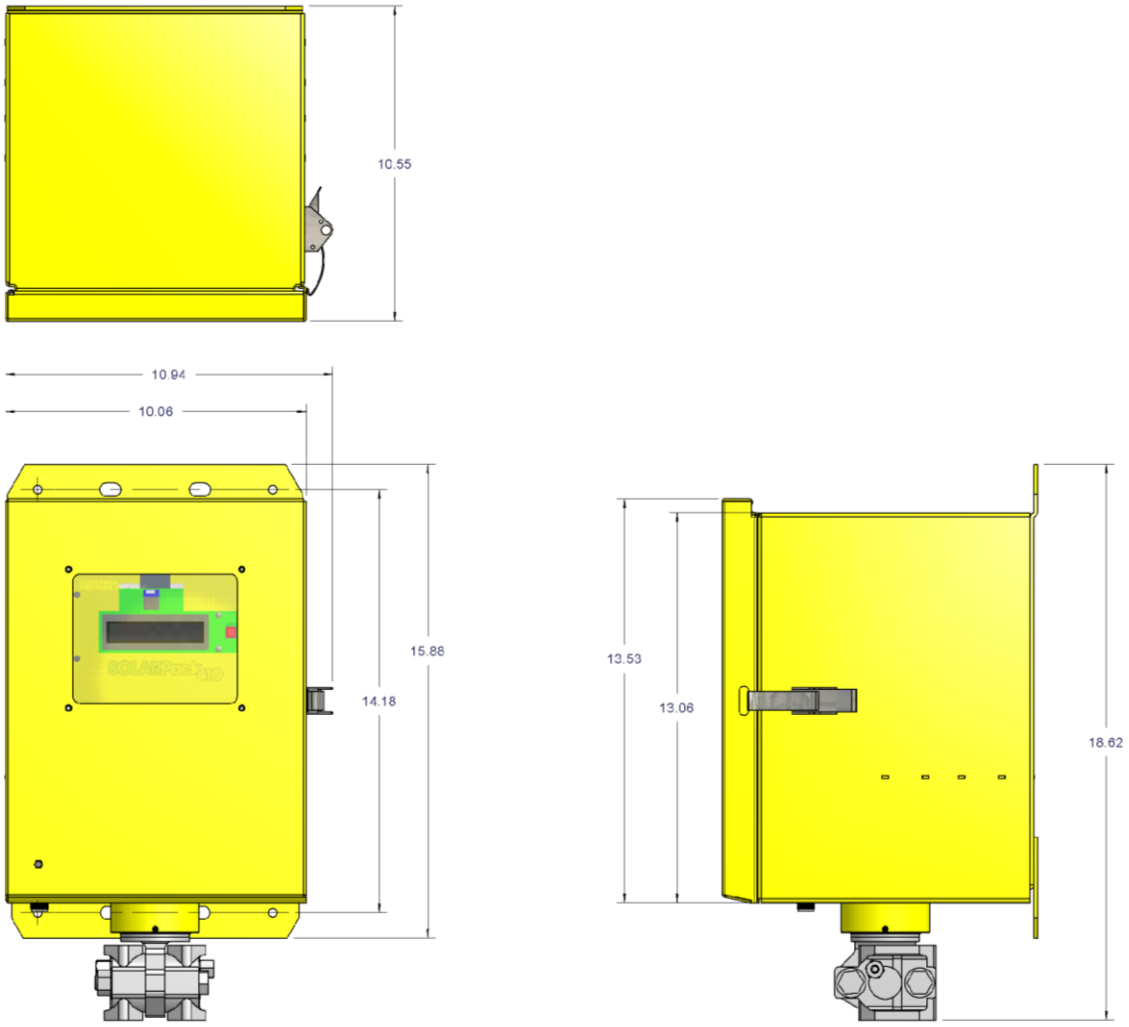


Figure 4-1: SOLARPack 410 Dimensions

4.2 Pole Mount Installation

The SOLARPack 410 can be mounted on a 2 inch (2.375 inch outside diameter) pipe using the pipe mount clamps supplied. *Figure 4-2: SOLARPack 410 Pipe Mounting*

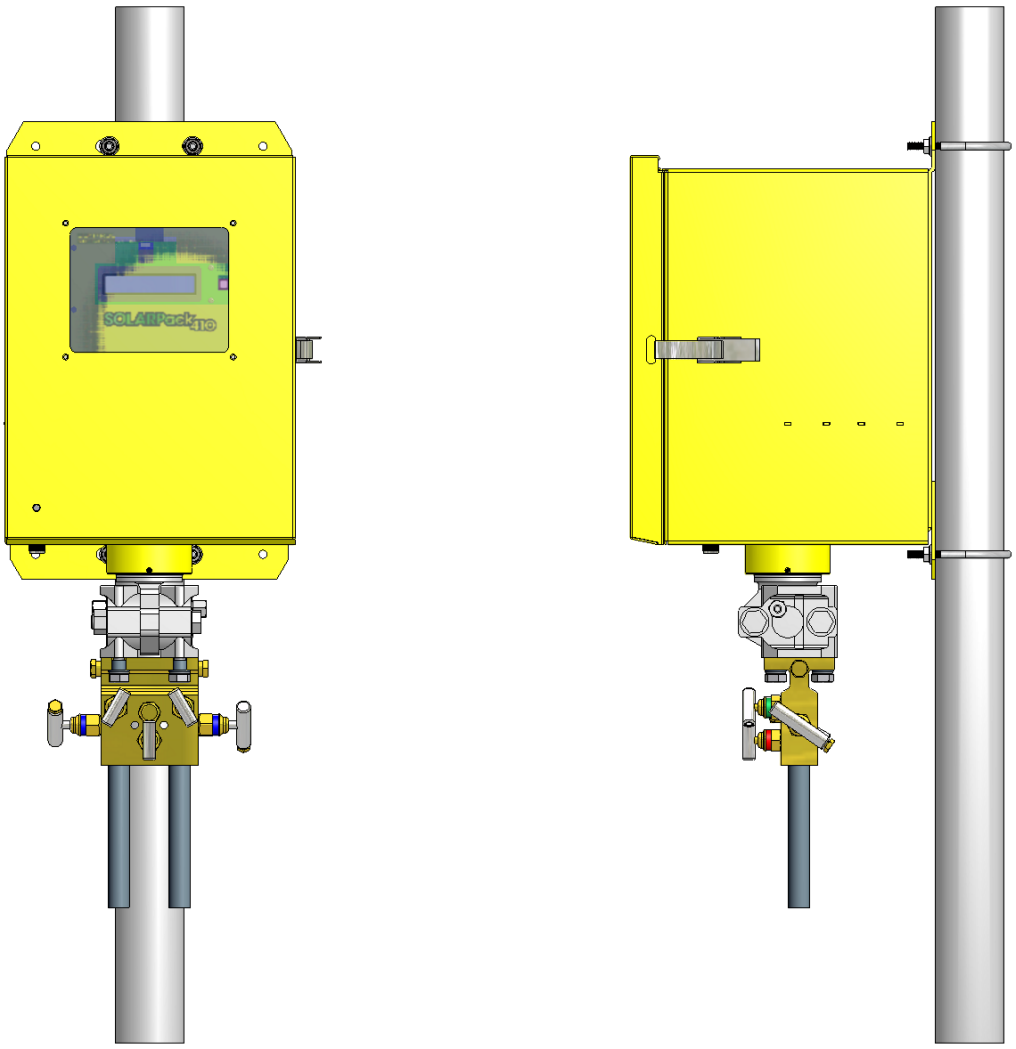


Figure 4-2: SOLARPack 410 Pipe Mounting

4.3 Wall and Metal Frame Mount Installation

The SOLARPack 410 may be wall mounted using the holes supplied on the mounting tabs. The SOLARPack 410 is mounted on industry standard metal framing systems. Vertical channels should be spaced 7.87 inches center to center. Horizontal channels should be spaced 14.18 inches center to center.

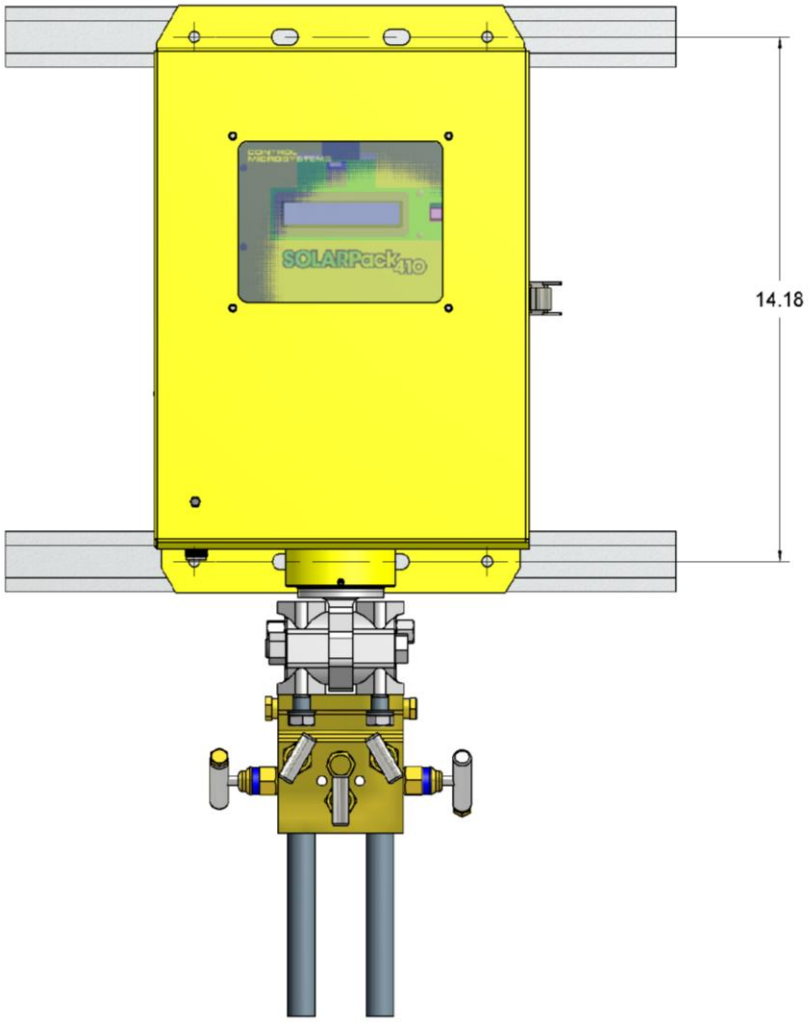


Figure 4-3: Horizontal Metal Frame Mounting

Figure 4-4: Vertical Metal Frame Mounting

4.4 Solar Panel Mounting

The SOLARPack 410 can be supplied with solar panels ranging from 5W to 30W. See ***5.5 Solar Panel Selection*** for a range of solar panels available from Control Microsystems.

4.4.1 5W Solar Panel

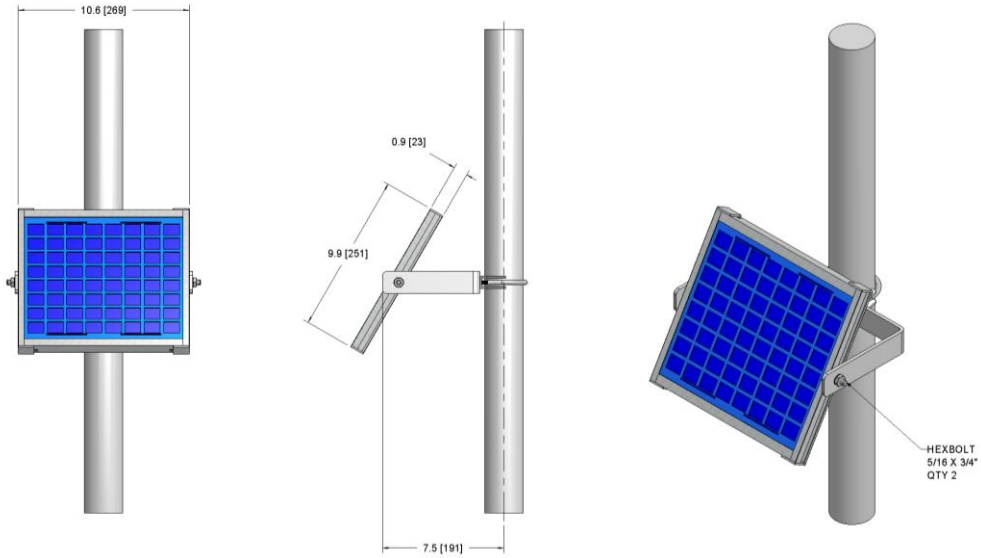


Figure 4-5: 5W Solar Panel Mounting

4.4.2 10W Solar Panel

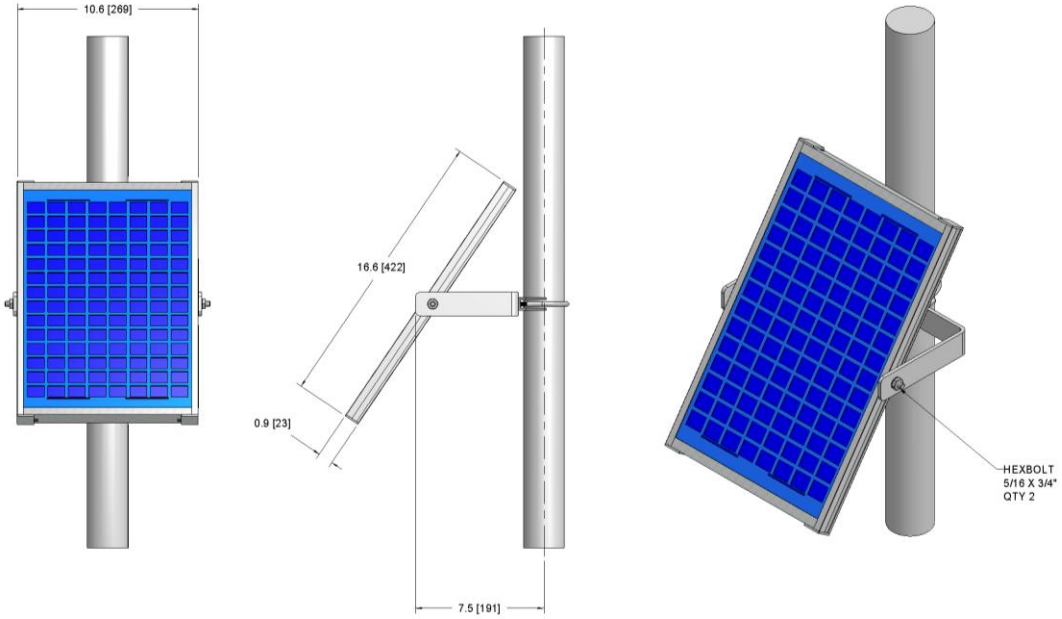


Figure 4-6: 10W Solar Panel Mounting

4.5 Process Connections

4.5.1 Integrated Sensor Version

The internal sensor version of the SOLARPack 410 has the sensor mounted at the bottom of the SOLARPack 410 chassis. The process piping is typically brought to the 5 – Valve manifold on the SOLARPack 410.

The SOLARPack 410 ships with the sensor HIGH side port to the left side. Bring the high pressure process piping to this port on the manifold. Bring the low pressure process piping to the sensor LOW side port.

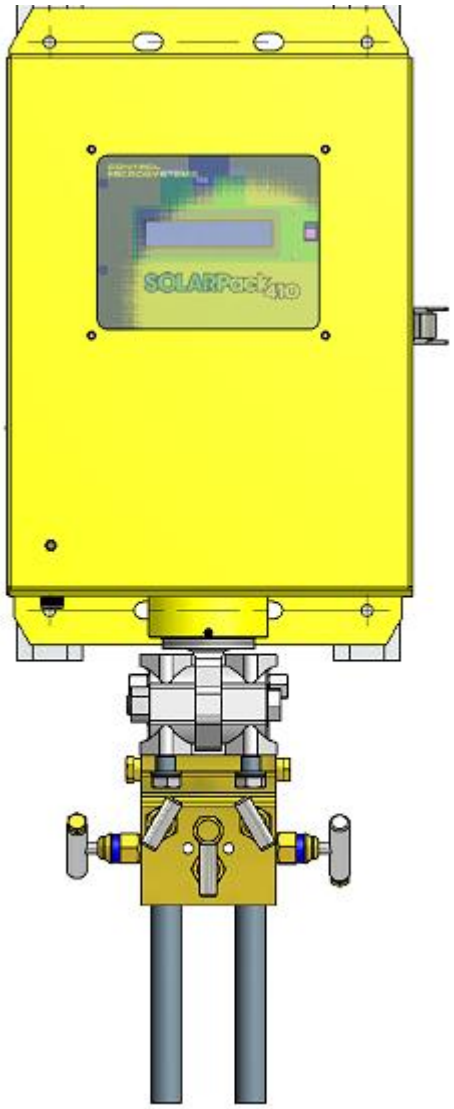


Figure 4-7: SOLARPack 410 Process Connections

4.5.1.1 Sensor Alignment and Replacement

The sensor is shipped with the H side port to the left and the L side port to the right. If necessary the sensor can be realigned. Loosen the two set screws. It is now possible to rotate the sensor by ±180º from the shipped position. Retighten the two set screws.

CAUTION: Do not rotate the sensor by more than ±180º. Damage to the sensor cable may result.

Refer to ***Figure 4-8: Sensor Interface*** and ***Figure 4-9: Sensor and sensor interface*** when removing and installing a sensor.

The sensor is removed as follows:

1. Remove the battery.
2. Remove the sensor interface to main board cable from the sensor interface board.
3. Remove the 4 screws that support the sensor interface board. Note that one of the screws connects the sensor interface cable shield to the sensor interface board. Note also that there are two holes in the battery shelf that allow access to the two screws at the back.
4. Remove the senor cable from the underside of the sensor interface board.
5. Loosen the two set screws that prevent the sensor from rotating.
6. Unthread (CCW) the sensor entirely. Note the sensor cable must be slid through the collar on an angle.

A replacement sensor is installed as follows:

1. Slide the sensor cable connector at an angle through the collar and into the enclosure.
2. Thread (CW) in the replacement sensor until it bottoms out. Unthread (CCW) by 180º. Continue to unthread as much as necessary to ensure the H side sensor port is on the left and the L side sensor port in on the right.
3. Follow steps 1 through 5 above in the reverse order.

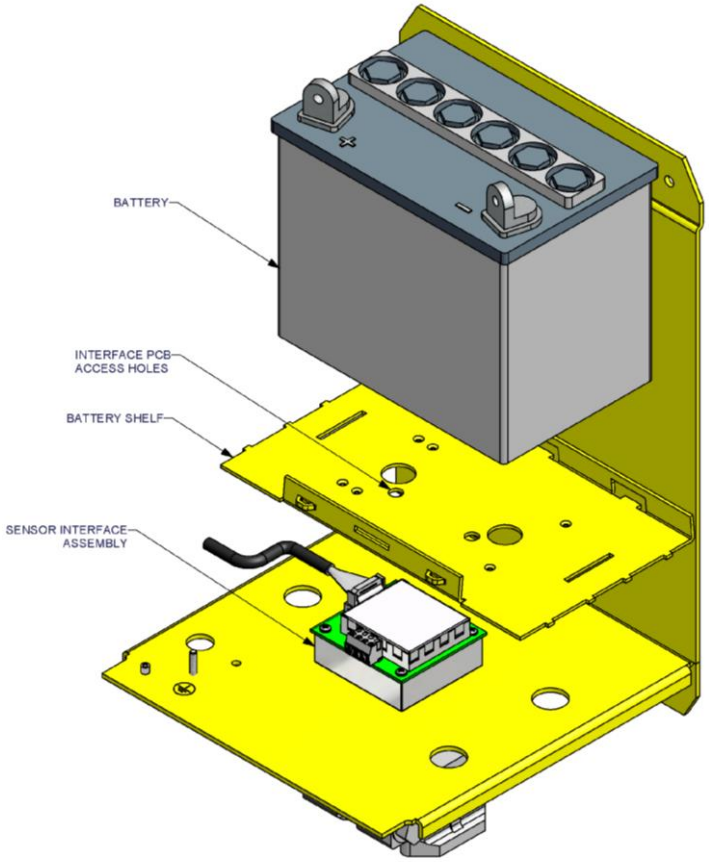


Figure 4-8: Sensor Interface

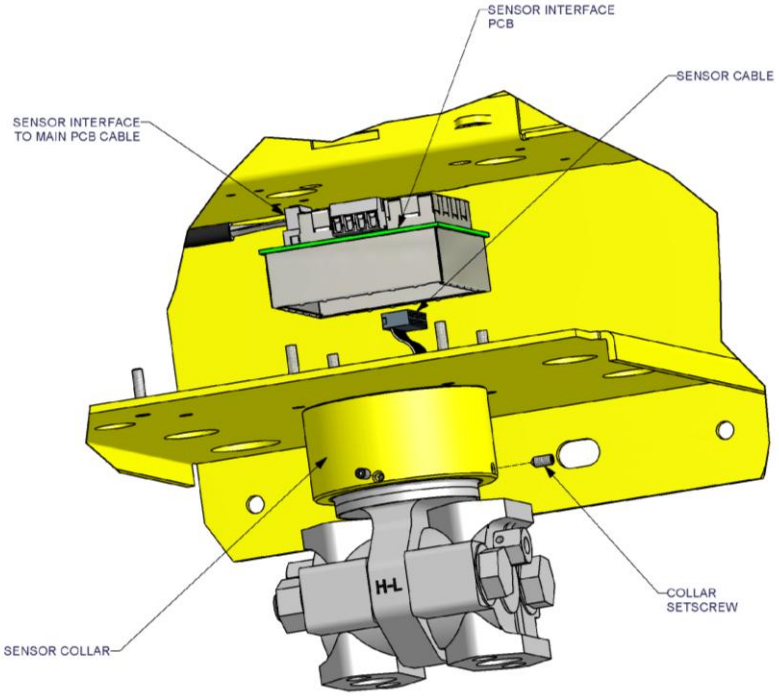


Figure 4-9: Sensor and sensor interface

4.5.2 Remote Sensor Version

The Remote Sensor version of the SOLARPack 410 requires a SCADASense 4102 with Remote Sensor firmware for pressure and temperature measurement. The SCADASense 4102 provides the process and RTD connections. See the **SCADASense 4000 Series User Manual** for complete information on the installation of the SCADASense 4102.

The SCADASense 4102 can be supported by the process piping as shown in ***Figure 4-10: Process-Mounted - Flange Mounting*** or mounted to a vertical or horizontal pipe or surface using the optional mounting bracket shown in ***Figure 4-11: Mounting SCADASense 4102 to a Pipe or Surface – Flange Mounting***.

NOTE: The transmitter should be mounted so that any moisture condensing or draining into the field-wiring compartment can exit through one of the two threaded conduit connections.

CAUTION !
To avoid damage to the 4000 Series sensor, do not use any impact devices, such as an impact wrench or stamping device, on the transmitter.

NOTE: Use a suitable thread sealant on all connections.

4.5.2.1 Process - Mounted Transmitter

The SCADASense 4102 series transmitters may be mounted to and supported by the process piping as shown in ***Figure 4-10: Process-Mounted - Flange Mounting***.

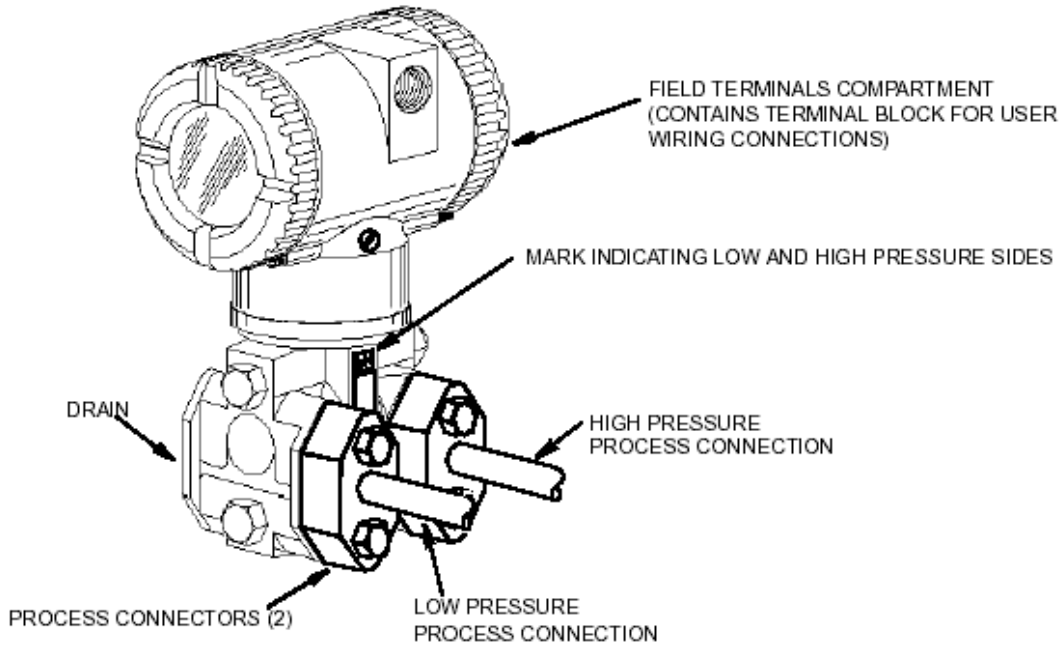


Figure 4-10: Process-Mounted - Flange Mounting

4.5.2.2 Pipe - or Surface-Mounted Transmitter

To mount a SCADASense 4102 to a pipe or surface, use the Optional Mounting Bracket Set (Model Code Option -M). Refer to ***Figure 4-11: Mounting SCADASense 4102 to a Pipe or Surface – Flange Mounting***, secure the mounting bracket to the SCADASense 4102 using the two lock washers and screws provided. Mount the SCADASense 4102 with mounting bracket to a vertical or horizontal, DN 50 or 2-in pipe. To mount to a horizontal pipe, turn the U-bolt 90° from the position shown in ***Figure 4-11: Mounting SCADASense 4102 to a Pipe or Surface – Flange Mounting***. The mounting bracket can also be used for wall mounting by securing the bracket to a wall using the U-bolt mounting holes.

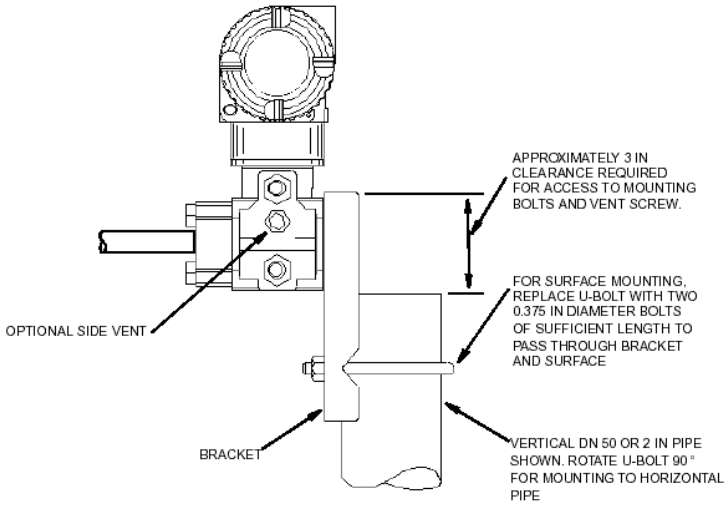

APPROXIMATELY 3 IN CLEARANCE REQUIRED FOR ACCESS TO MOUNTING BOLTS AND VENT SCREW.
FOR SURFACE MOUNTING, REPLACE U-BOLT WITH TWO 0.375 IN DIAMETER BOLTS OF SUFFICIENT LENGTH TO PASS THROUGH BRACKET AND SURFACE
OPTIONAL SIDE VENT
BRACKET
VERTICAL DN 50 OR 2 IN PIPE SHOWN. ROTATE U-BOLT 90° FOR MOUNTING TO HORIZONTAL PIPE

Figure 4-11: Mounting SCADASense 4102 to a Pipe or Surface – Flange Mounting

4.5.2.3 Positioning Transmitter Housing

The transmitter housing (top works) can be rotated up to one full turn in the counterclockwise direction when viewed from above for optimum access to adjustments, display, or conduit connections.

Note:	Do not rotate the housing more than one turn from the "as received" position. If there is doubt about the housing rotational position, turn fully clockwise and then back off no more than one full turn.
WARNING:	The small setscrew on the housing keeps the housing from being rotated too far. This is NOT a locking screw. Do not tamper with this screw. Damage to the housing can occur if this setscrew is tampered with.

4.5.2.4 Manifold Types and Installation

Several manifold models are available to interface a transmitter with the process piping. The PGI-M573 has ½" FNPT inlets and ½" FNPT outlets, while the PGI-M673 has ½" FNPT inlets and Instrument Flange outlets. Two options are available. The CDT option is of carbon steel construction while the SDJ option uses 316SS NACE construction (140F max) and has a fluorosilicone stem seal.

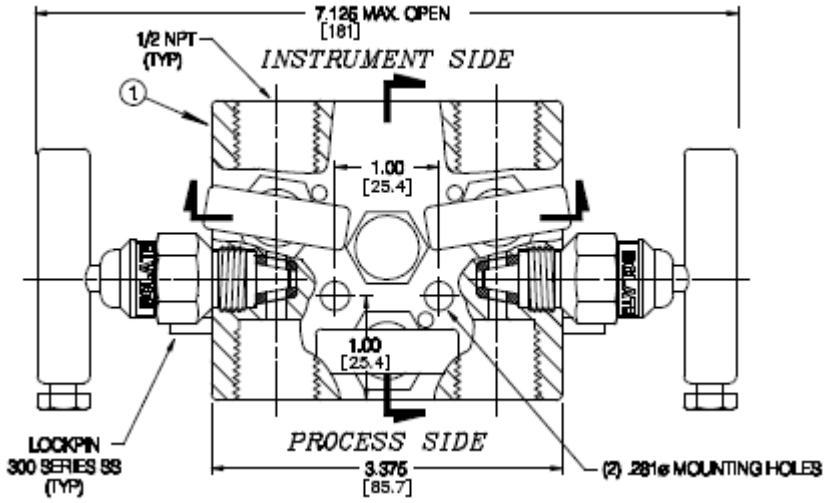


Figure 4-12: PGI-M573 Five Valve Manifold

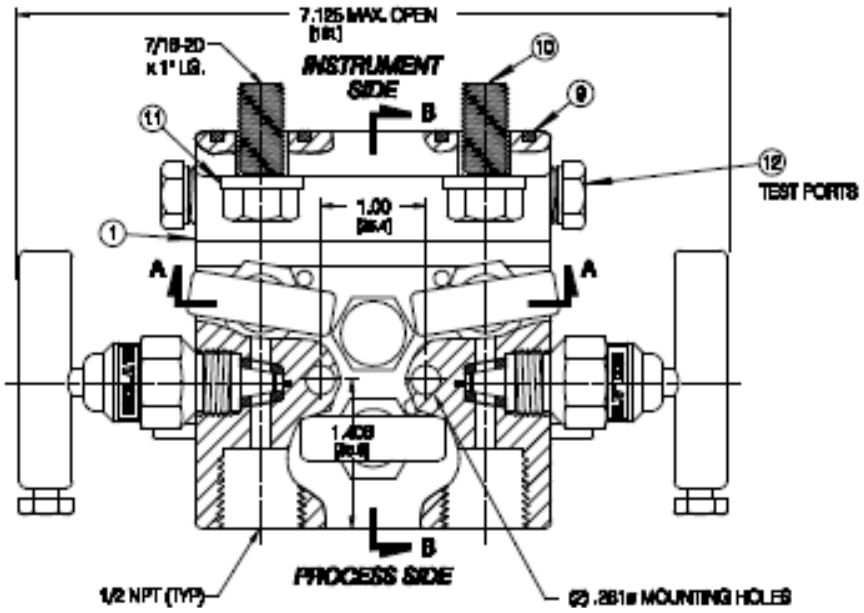


Figure 4-13: PGI-M673 Five Valve Manifold

The bolts to mount the PGI-M673 model to the sensor are 7/16-20 x 1”

4.5.2.5 Connections for Sensor Calibration

It should be noted that when an Absolute (Static) Pressure calibration is performed the bypass or cross feed valve on the manifold must be open. When performing a Differential Pressure calibration the bypass valve must be closed.

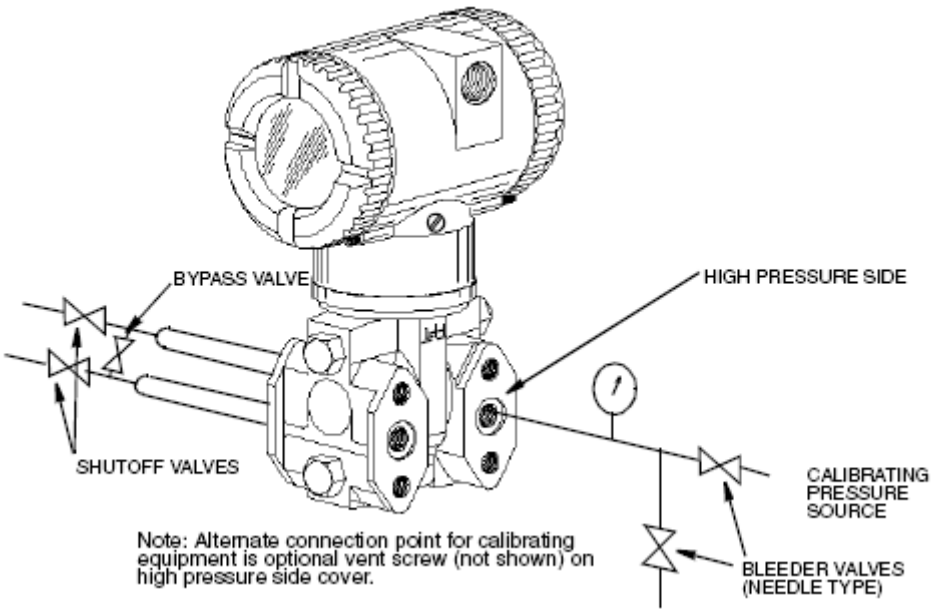


Figure 4-14: Differential Pressure Calibration Connections

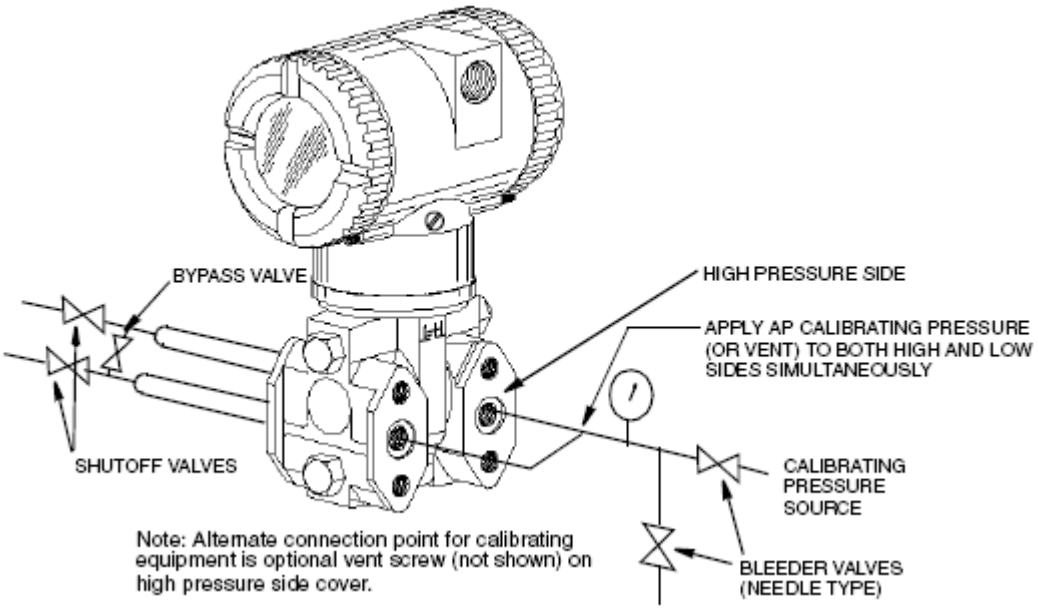


Figure 4-15: Absolute Pressure Calibration Connections

5 Wiring and Connections

This section of the user manual describes the connection and wiring details for the SOLARPack 410.

5.1 Communication Ports

See ***Figure 5-1: SOLARPack 410 Communication Ports*** for an overview of the SOLARPack 410 communication ports.

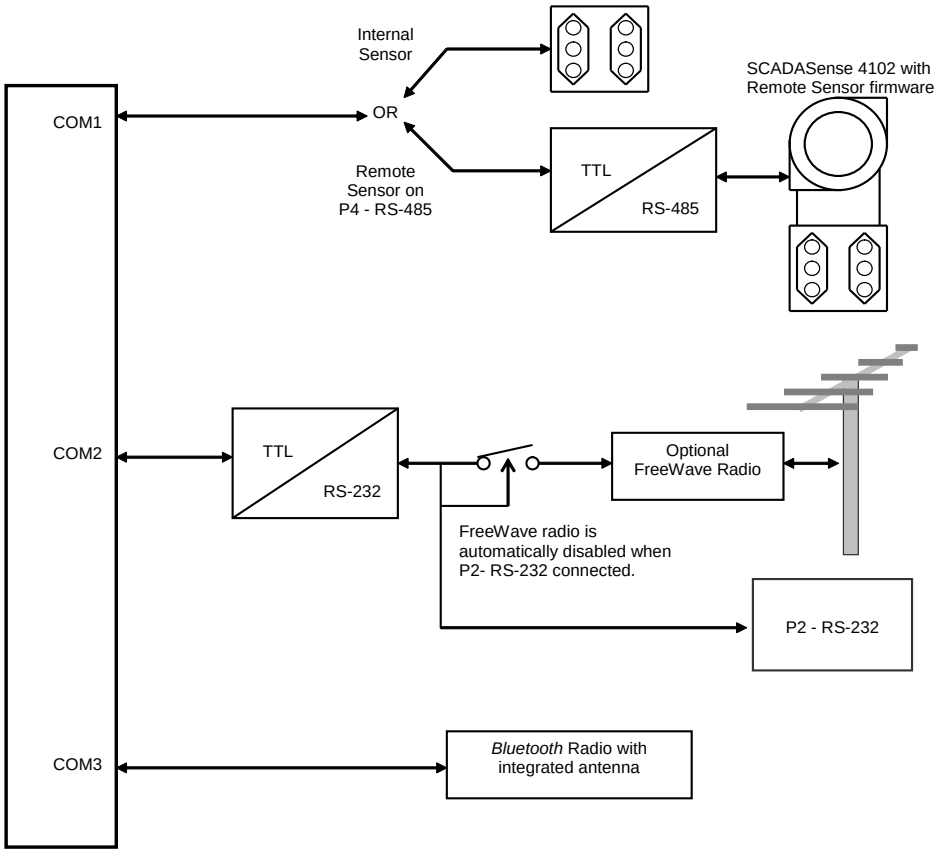


Figure 5-1: SOLARPack 410 Communication Ports

5.1.1 COM Port 1 – Sensor Interface Port

The COM 1 port is connected to an internal or remote sensor interface module. The internal connection is a TTL level serial interface. The external connection is RS485. The SOLARPack 410 detects the sensor interface connected.

The following parameters can be set using RealFLO.

Parameter	Valid Values	Default
Baud rate	19200	19200 No other baud rate will work with the sensor interface module.

Parameter	Valid Values	Default
Parity	None Even Odd	None
Data bits	7 8	8
Stop bits	1 2	1

5.1.2 COM Port 2 – Radio Port and RS232 Port

The COM 2 port is connected to the internal radio connector or to the com2 RS-232 connector. Hardware detects when a device is plugged into the RS-232 connector and disables the signals to the radio.

The following parameters can be set using RealFLO.

Parameter	Valid Values	Default
Baud rate	300 600 1200 2400 4800 9600 19200 38400 57600 115200	9600
Parity	None Even Odd	None
Data bits	7 8	8
Stop bits	1 2	1
Rx Flow control	None Modbus RTU	Modbus RTU
Tx Flow control	Use CTS	Use CTS

5.1.3 COM Port 3 – Bluetooth Port

The integrated BlueRadios Bluetooth communication module is connected to the COM 3 serial port.

The SOLARPack 410 includes an integrated *Bluetooth* Class I communications module. This is the primary method of local communications to the SOLARPack 410.

Class I *Bluetooth* allows up to 100m (330 feet) line of sight communications. This is under ideal conditions and is affected by the power, sensitivity, class and orientation of the host *Bluetooth* as well as the orientation and obstructions in the SOLARPack 410 installation. Reliable communications may not be possible unless the distance is less than 100m (330 feet).

The *Bluetooth* communications module consumes significant power. There are provisions in the RealFLO configuration to power down the *Bluetooth* module. See the ***6.2 - Power Management*** section for details on controlling the Bluetooth power. When the *Bluetooth* communications module is powered up the LCD display will have an antenna icon in the lower right corner.

The following parameters can be set using RealFLO. However, the baud rate should never be changed.

Parameter	Valid Values	Default
Baud rate	1200 2400 4800 9600 19200 38400 57600 115200	115200
Parity	None	None
Data bits	8	8
Stop bits	1	1
Rx Flow control	None Modbus RTU	Modbus RTU
Tx Flow control	Use CTS	Use CTS
Duplex	Full	Full

5.2 Using *Bluetooth* Communications

A *Bluetooth* transceiver and software driver needs to be installed on the laptop in order to discover and use the SOLARPack *Bluetooth* port. There are a number of *Bluetooth* transceivers available and it would be difficult to attempt to describe them all in this document. The following configuration is for the Control Microsystems SCADAWave 5914 USB adaptor. Most *Bluetooth* devices follow a similar installation and configuration process. Use this section as guide for your *Bluetooth* device.

NOTE: The SOLARPack 410 factory default Bluetooth PIN is **default**. You will need to use this PIN if requested by the Bluetooth device.

5.2.1 Install SCADAWave 5914 USB Adaptor

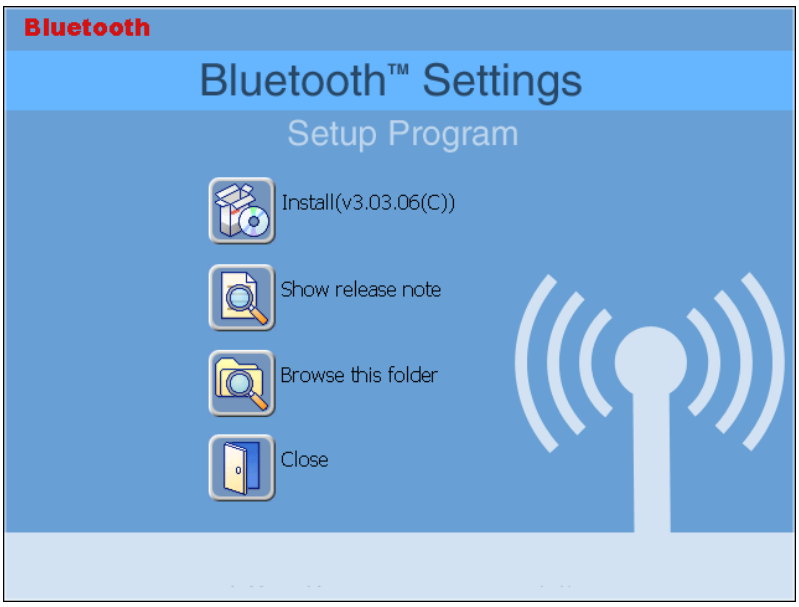
The SCADAWave 5914 (USB) is installed by plugging the unit into an available USB slot on your PC. When properly connected to a USB port the blue indicator led on the SCADAWave 5914 USB *Bluetooth* will be on.

5.2.2 Install SCADAWave 5914 USB Software Driver

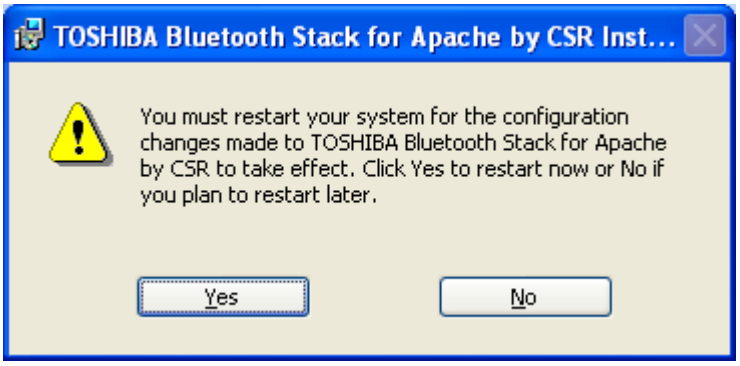
The software driver is installed from the CD ROM that came with the SCADAWave 5914. This CD contains the Toshiba *Bluetooth* stack and User Interface for Microsoft Windows platforms (98SE, 2000, ME, XP). The installation will automatically start and open the Setup Program splash screen.

Note: The SCADAWave 5914 is **NOT** supported on Windows Server 2003 operating system.

- Click the Install button to start the Installation Wizard. The Installation Wizard will guide you through the installation.



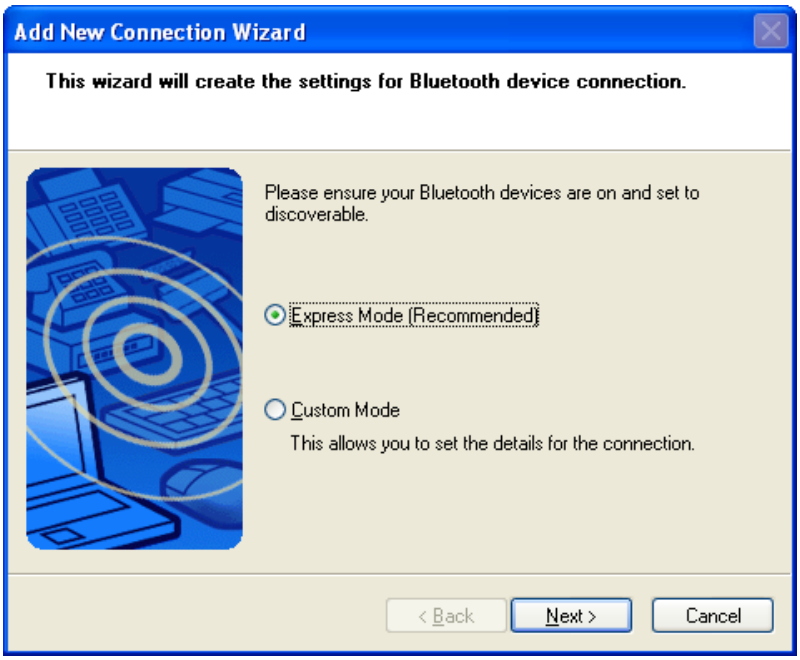
When prompted, you will need to restart your PC.


TOSHIBA Bluetooth Stack for Apache by CSR Inst...
You must restart your system for the configuration changes made to TOSHIBA Bluetooth Stack for Apache by CSR to take effect. Click Yes to restart now or No if you plan to restart later.
Yes
No

5.2.3 Configure Bluetooth Connection

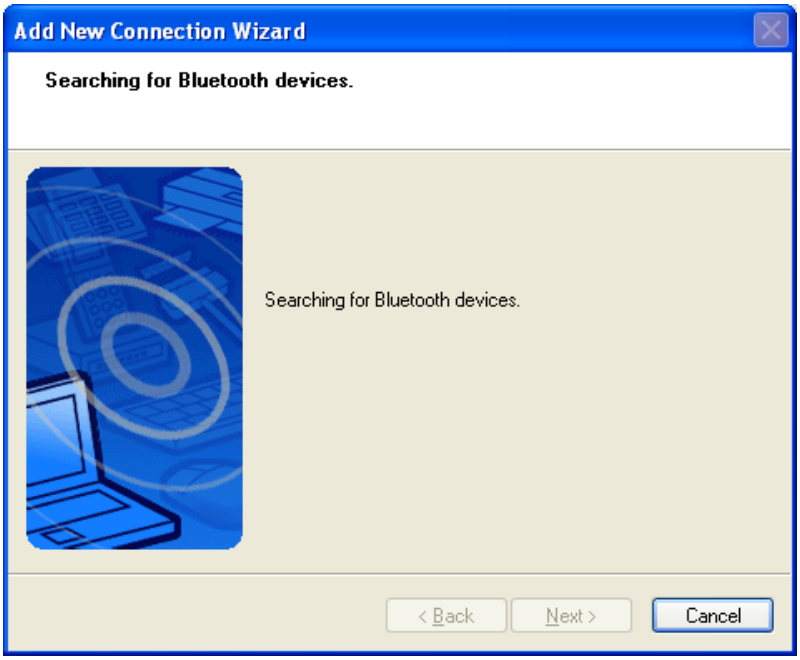
The *Bluetooth* User Interface may now be started from the Windows **Start** >> **All Programs** >> ***Bluetooth*** >> ***Bluetooth*** **Settings** command.

This command starts the Connection Wizard which will guide you through the steps to create a *Bluetooth* connection between the SCADAWave 5914 and SCADAWave 5913.

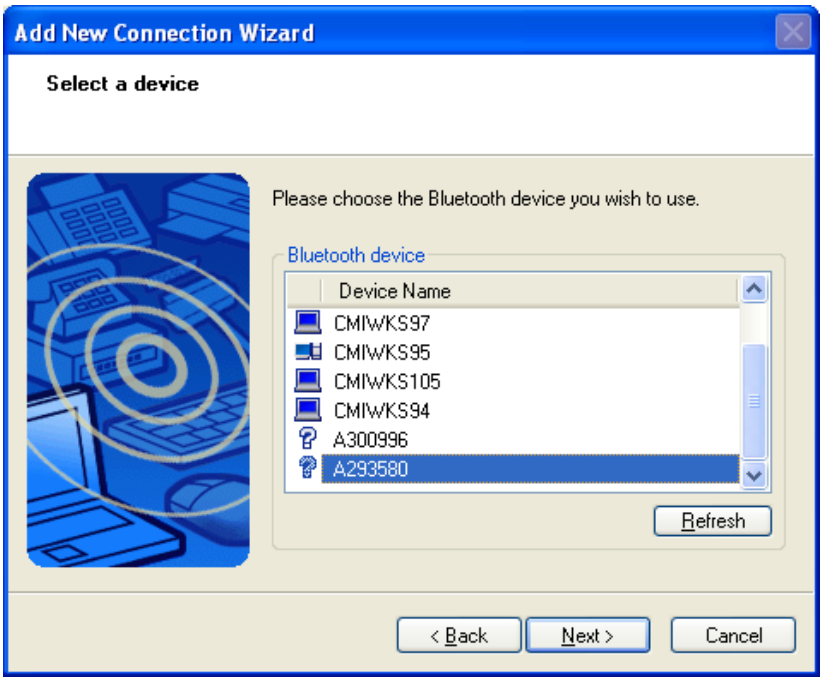

Add New Connection Wizard
This wizard will create the settings for Bluetooth device connection.
Please ensure your Bluetooth devices are on and set to discoverable.
Express Mode (Recommended)
Custom Mode
This allows you to set the details for the connection.
< Back
Next >
Cancel

- Select **Express Setup** and click the **Next** button. .

Connection Wizard will begin to search for all *Bluetooth* devices within range, approximately 300 feet. A communication progress dialog is displayed as shown below.

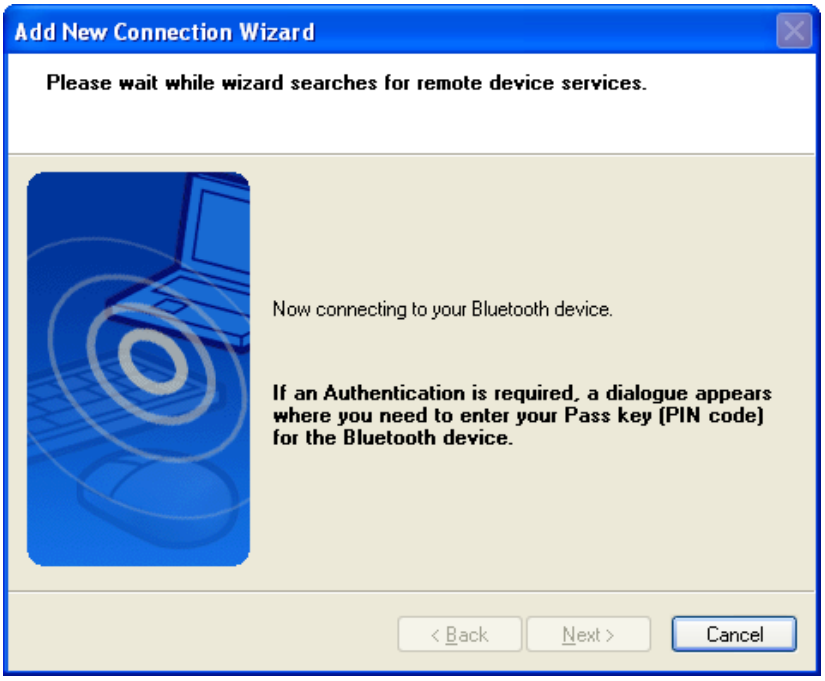


Once the connection wizard has found all *Bluetooth* devices they are displayed in the Device Name window. The SOLARPack 410 will be displayed with the SOLARPack 410 serial number. Each SOLARPack 410 has an individual serial number. To confirm the serial number of your SOLARPack 410 check the white sticker on the SOLARPack 410 controller board.



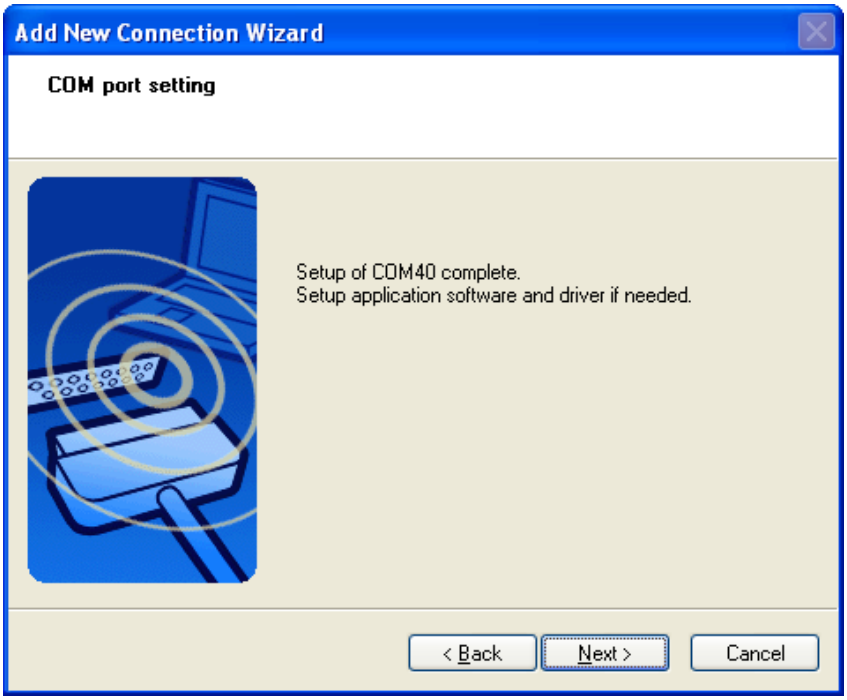
- Click on the SOLARPack 410 serial number and click the **Next** button. Note that the device name can be changed at a later step in the connection wizard.

The connection wizard will now connect to the SOLARPack 410. The following progress dialog is displayed.

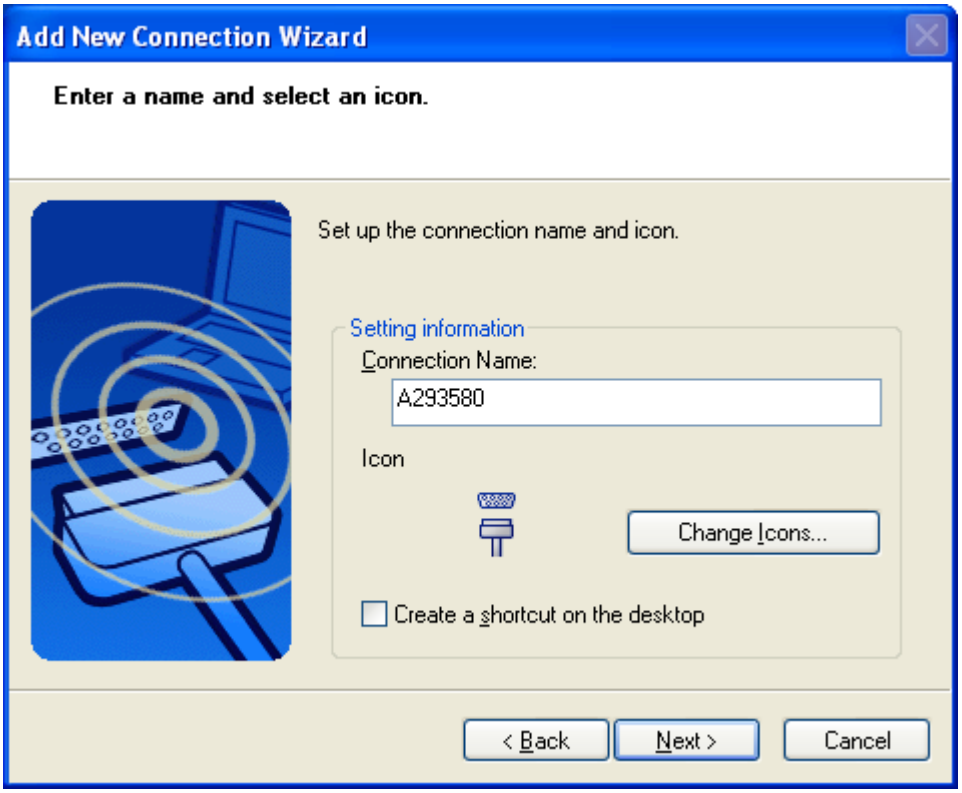

Add New Connection Wizard
Please wait while wizard searches for remote device services.
Now connecting to your Bluetooth device.
If an Authentication is required, a dialogue appears where you need to enter your Pass key (PIN code) for the Bluetooth device.
< Back
Next >
Cancel

NOTE: The SOLARPack 410 factory default Bluetooth PIN is **default**. You will need to use this PIN if requested by the Bluetooth device.

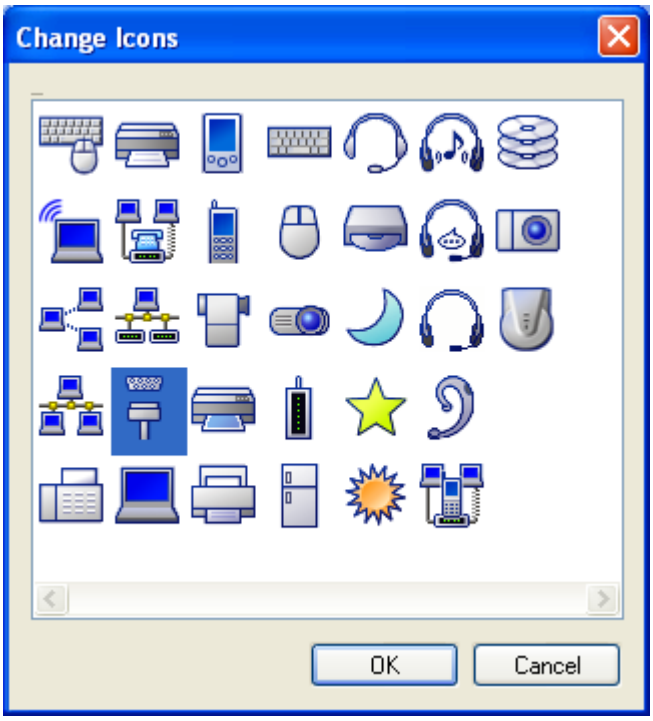
The wizard automatically creates a virtual serial connection typically with **Com40** as the first com port. Note that this is the port you will need to select when setting the **PC Communication Settings** in your application.



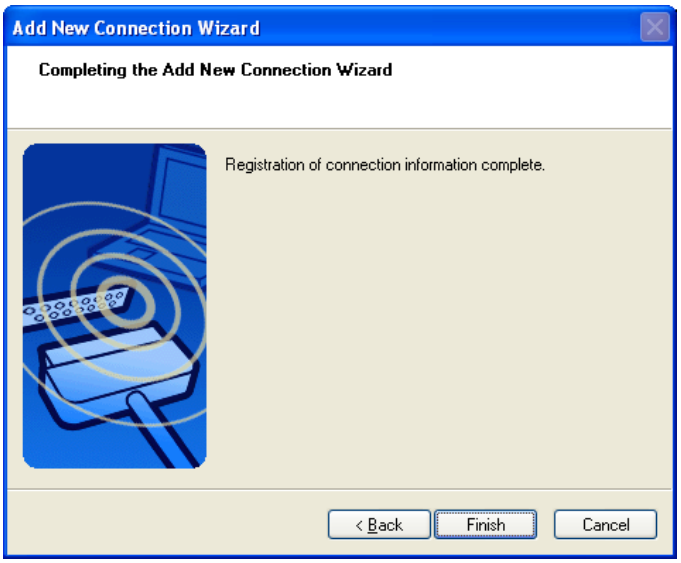
Next the connection wizard lets you customize the connection. You can create name for the connection, i.e. site 122 etc.



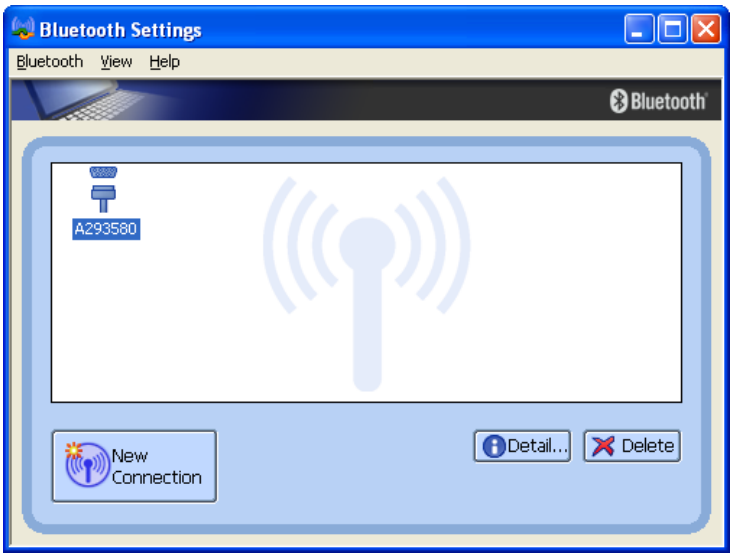
Selecting the **Change Icon** button opens a dialog with available icons. You can choose a new icon for the connection if desired.



Once the configuration is finished the connection is complete.



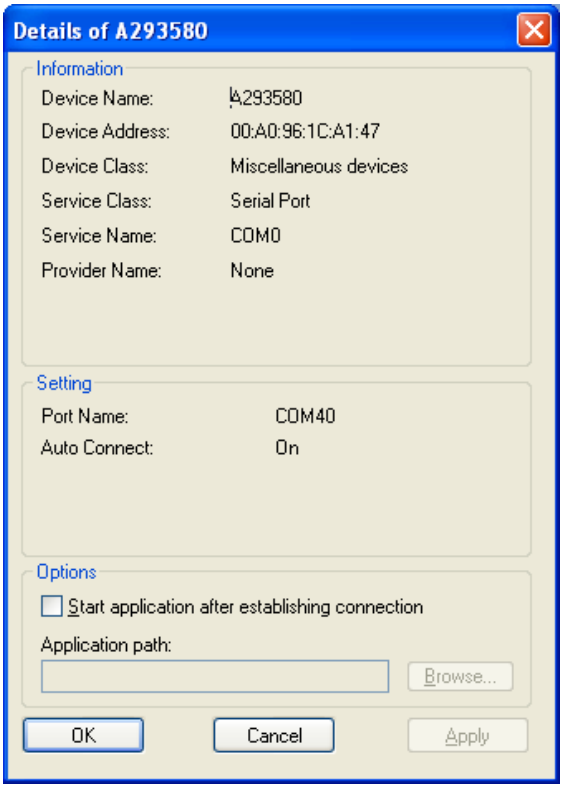
The *Bluetooth* settings dialog now show the connection and enables you to connect with the SOLARPack 410.



From the *Bluetooth* menu select connect to connect with the SOLARPack 410. Note that right clicking on the icon allows the Connect selection as well.

The *Bluetooth* connection is now ready for applications.

- Click the Details button to see a dialog with the device details.



The Options section of the Details dialog is used to start an application such as RealFLO or TelePACE whenever a *Bluetooth* connection is made with a SCADAWave 5913.

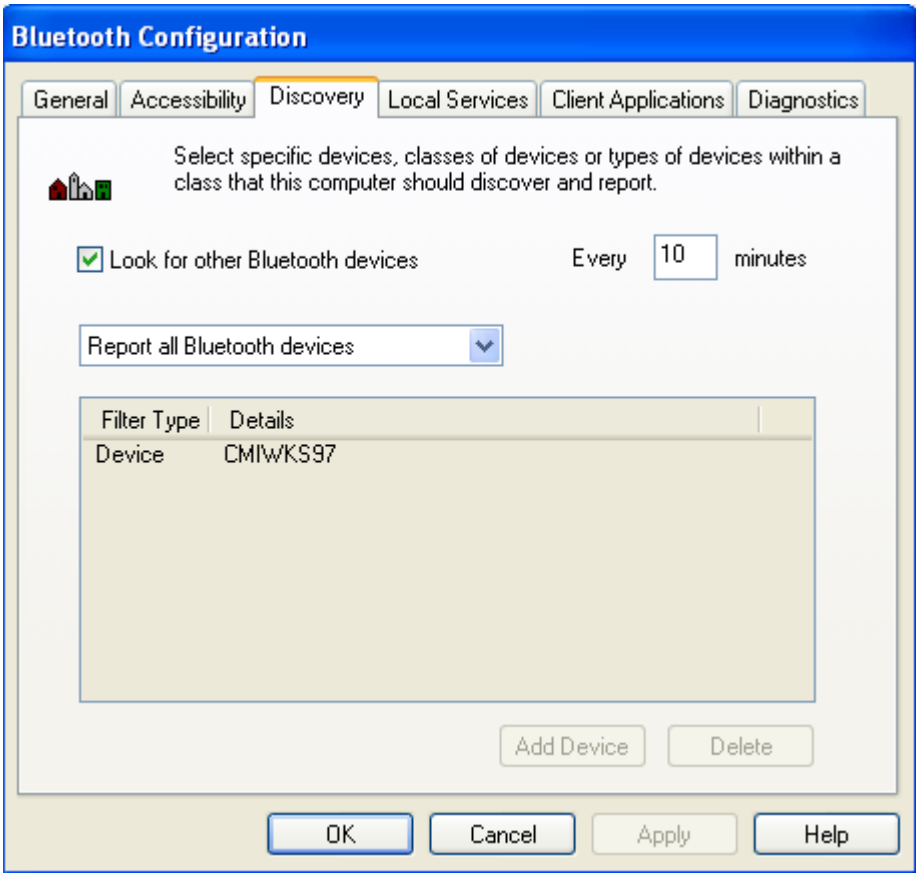
- Click the **Start application after establishing connection** check box and then browse to the executable file for the application.

5.2.4 Configure Internal Laptop Bluetooth Connection

If your laptop or PC has an internal *Bluetooth* adapter you can use it to establish a *Bluetooth* connection with the SCADAWave 5913. Refer to your user manual for details on establishing a *Bluetooth* connection.

Note	If the 5913 is used with a laptop using a built-in class 2 *Bluetooth* device, the range will be limited by the class 2 device (approximately 3m or 10 ft.)

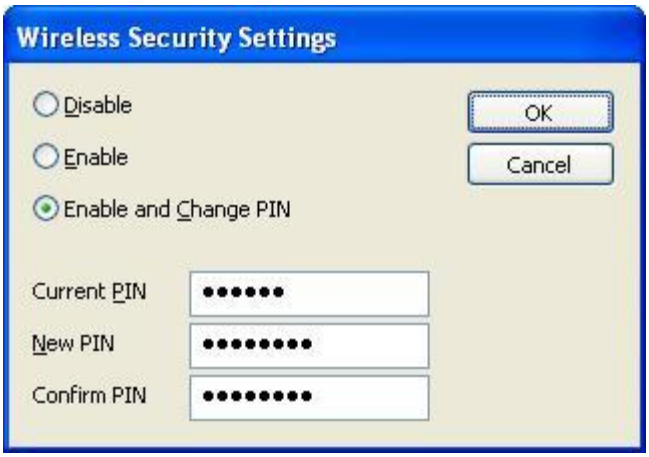
The internal Bluetooth may not be set up for automatic discovery. This needs to be enabled in your configuration software. An example of the correct settings are shown in the following picture.



5.2.5 RealFLO Wireless Security Settings

The Bluetooth security settings are configured using RealFLO. With RealFLO open:

- Select the **Bluetooth Security** command on the **Configuration** menu to open the Wireless Security Settings configuration dialog.



Select **Disable** to operate the wireless radio without security. Select **Enable** to use authentication and encryption. Select **Enable and Change PIN** to use authentication and encryption with a new PIN.

Current PIN specifies the current value of the PIN. Valid values are up to 10 alphanumeric characters (a to z, A to Z, and 0 to 9). The PIN is case sensitive. Characters entered are masked. Copy and paste are disabled (so the user must type the PIN).

New PIN specifies the new value of the PIN. This control is enabled if **Enable and Change PIN** is selected. Valid values are up to 10 alphanumeric characters (a to z, A to Z, and 0 to 9). The PIN is case sensitive. Characters entered are masked. Copy and paste are disabled (so the user must type the PIN).

Confirm New PIN specifies the new value of the PIN. This control is enabled if **Enable and Change PIN** is selected. Valid values are up to 10 alphanumeric characters (a to z, A to Z, and 0 to 9). The PIN is case sensitive. Characters entered are masked. Copy and paste are disabled (so the user must type the PIN).

The two values of the new PIN must match before any settings are written to the controller.

Click **OK** to write the new settings to the controller. An error message is displayed if the settings cannot be written to the controller and the dialog remains open.

Click **Cancel** to close the dialog without making any changes.

5.2.6 Indicator LEDs

There are 5 LEDs on the SOLARPack 410, RX, TX, STAT, RUN and FORCE. The LEDs are normally off to save power. Press the LED PWR switch once to enable the LEDs. Press the LED PWR switch once again to disable the LEDs.

The LEDs are described in ***Table 5-1: SOLARPack 410 LED Operation***. See ***Figure 5-2: LED and LED Power Switch Locations*** for the location of these LEDs.

Table 5-1: SOLARPack 410 LED Operation

LED	Function
STAT	Indicates the SOLARPack 410 Operating Mode. This LED is normally on when the LED POWER button is pushed. See section ***6.1 - Operating Modes*** for a complete description of the STAT LED modes.

LED	Function
RUN	Indicates the SOLARPack 410 flow computer program status. ON = Running. OFF= Not Running.
FORCE	Indicates if any of the sensor inputs are forced. ON indicates one or more inputs are forced. The inputs may be forced using RealFLO.
TX - COM2	Indicates data transmitted from the SOLARPack 410 to the radio if it is radio communication or RS-232 communication.
RX - COM2	Indicates data received from the SOLARPack 410 from the radio if it is radio communication or RS-232 communication.

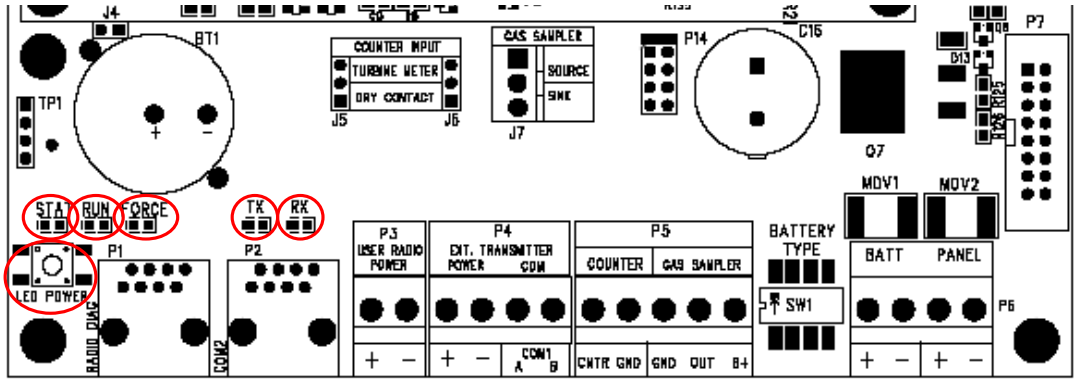


Figure 5-2: LED and LED Power Switch Locations

5.2.7 LED Power Switch

The LED power and reset switch, LED POWER is located to the left of the RADIO DIAG connector P1. Refer to ***Figure 5-2: LED and LED Power Switch Locations*** for the location.

The SOLARPack LEDs are normally off to save power. Press the LED PWR switch once to enable the LEDs. Press the LED PWR switch once again to disable the LEDs. The LEDs are disabled automatically after 5 minutes. The LEDs on the radio are not controlled by the LED PWR switch.

5.2.8 Sensor Interface Connector (P7)

Internal Sensor versions of the SOLARPack 410 have a shielded cable connected to P7 on the main SOLARPack 410 board to P2 on the sensor interface board. The cable shield is connected to the sensor interface board.

5.2.9 Security Jumper (J3)

The SOLARPack 410 security jumper is used to enable or disable programming commands and firmware uploads.

When in the **SECURITY ON** position:

- RealFLO cannot make changes to the SOLARPack 410 flow computer configuration.
- Host and HMI systems cannot make changes to the SOLARPack 410 flow computer configuration using the TeleBUS Command sequence.

- New firmware cannot be loaded into the SOLARPack 410

When in the **SECURITY OFF** position security is effectively disabled. RealFLO and HMI commands are processed by the SOLARPack 410. New firmware can be loaded into the SOLARPack 410.

Refer to ***Figure 5-3: Security (J3) Location*** for the position of the header and jumper link labeled J3.

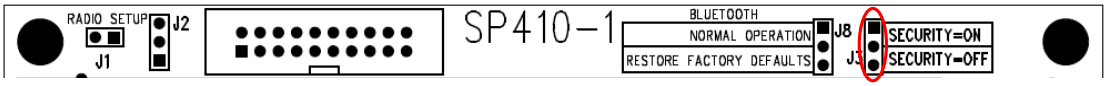


Figure 5-3: Security (J3) Location

5.2.10 Bluetooth Factory Default Reset Jumper (J8)

To restore the factory default settings in the *Bluetooth* module the jumper link is moved from the upper or "Normal Operation" to the lower or "Restore Factory Defaults" and back to the upper or "Normal Operation" position.

Note: The *Bluetooth* PIN is **NOT** reset using jumper J8.

The jumper link is left in the upper or "Normal Operation" position at all other times. Refer to ***Figure 5-4: Bluetooth Factory Default (J8) Location*** for the position of the header and jumper link labeled J8. Should this be in the Bluetooth section?

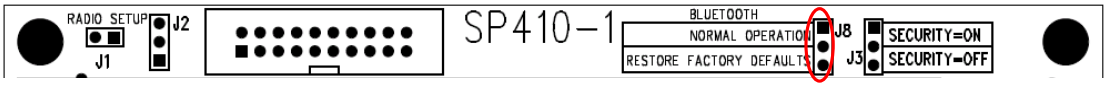


Figure 5-4: *Bluetooth* Factory Default (J8) Location

5.2.11 Factory Test Points

Several test points and programming headers have been installed on the SOLARPack 410 for manufacturing and test purposes. Do not connect to these points. Jumper links, if installed, should be left in the as shipped position. The test points and programming headers are labeled TP1, P8, P14, J2 and J4.

5.2.12 Lithium Battery

A small lithium battery powers the CMOS memory and real-time clock when input power is removed. The voltage of a functioning battery should be greater than 3.0V.

The Lithium battery voltage can be monitored from a Modbus register. See the ***7 - SOLARPack 410 Modbus Database Registers*** section for Modbus register addressing of the lithium battery voltage.

The battery should not require replacement under normal conditions. The shelf life of the battery is 10 years. The battery is rated to maintain the real-time clock and RAM data for two years with the power off. Accidental shorting or extreme temperatures may damage the battery.

5.2.13 Reflective Sensor

There is a reflective sensor labeled "Enable" installed in the SOLARPack 410 window just to the right of the LCD display. The sensor is activated by placing one's finger or other reflective object over the sensor for approximately one second. The reflective may not operate properly with non reflective objects such as a flat black glove.

Activating the enable input places the flow computer in the continuous power mode. A power off timer starts when entering continuous power mode. The flow computer remains in this mode until the power off timer expires, then enters the power saving mode.

The following parameters can be configured for this mode.

- Time in minutes until power off
- Radio power setting (ON or OFF)
- Bluetooth power setting (ON or OFF)
- Display setting (ON or OFF)
- Display backlight setting (ON or OFF)

RealFLO software is used to configure the above parameters. See section ***6.2 Power Management*** for details on configuring the parameters.

5.2.14 LCD Display

The SOLARPack 410 display is a 2-line by 20-character LCD. It shows alphanumeric text and indications of the battery power and radio status. Note that backlighting the display for extended periods will increase the SOLARPack 410 power consumption considerably. This should be considered when configuring the backlighting operation.

At ambient temperatures below –20ºC (–4ºF) the display will become slow to respond to changes. Long term storage and operation outside of these limits is not recommended.

Refer to ***Table 5-3*** for an explanation of the battery charging state shown in the upper right corner of the LCD display.

Refer to ***5.2 Using Bluetooth*** **Communications** for an explanation of the antenna icon in the lower left corner of the LCD display.

5.3 Antenna

An external antenna is required when the SOLARPack 410 includes the optional FreeWave radio or a user supplied radio.

When the SOLARPack 410 is supplied with the optional FreeWave radio there is a SMA to N-male cable assembly from the FreeWave radio to the bulkhead surge protector.

When the SOLARPack 410 is supplied without a radio the user is responsible for the bulkhead connection and surge protection. Control Microsystems recommends PolyPhaser model IS-B50LN-C2 (Control Microsystems part number 297273).

The antenna should be mounted at the highest point on the pole. A variety of optional antennae are available from Control Microsystems. These antennae include mounting hardware and instructions. Follow the manufacturer's instruction to mount the antenna.

Ensure there is enough coax feed line to reach from the antenna connection to the SOLARPack 410 surge suppressor connection at the bottom of the SOLARPack 410. Connect the coax feed line to the antenna and seal the connection with weatherproof tape.

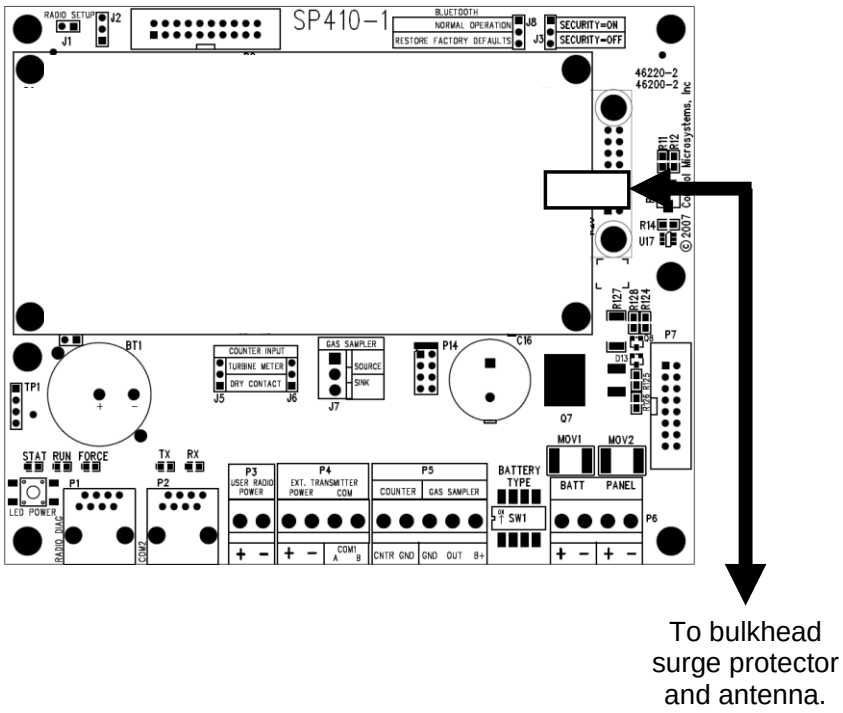


Figure 5-5: Antenna to integrated FreeWave Radio

5.4 Battery Connection

5.4.1 Battery Types and Selection

The following batteries have been approved for use with the SOLARPack 410.

CAUTION:	Use only batteries that have been recommended or supplied by Control Microsystems. Battery must be a 12V nominal Gelled electrolyte (Gel), Absorbed Glass Mat (AGM) valve regulated lead acid (VRLA) battery or Cyclon pure lead type battery. Battery height, including terminals, must not exceed 7.5 inches. See below for additional battery types supported.

Table 5-2 Battery Selection

Manufacturer **Type**	**Model Number** **CMI Part Number**	**Capacity**	**Charging requirements** **DIP switch settings**
Deka - East Penn Sealed Gel	8GU1 298248	31.6A-hr. 20 hours to 1.75V/cell	13.8V charge 13.5V float
Deka - East Penn Absorbed Glass Mat	8AU1 298249	31.6A-hr. 20 hours to 1.75V/cell	14.4V charge 13.8V float
Sonnenschein	A512/30 G6	30A-hr.	14.4V charge 13.8V float
Power Sonic	PS-12350NB	35A-hr.	14.4V charge

Manufacturer Type	Model Number CMI Part Number	Capacity	Charging requirements DIP switch settings
		20 hours to 1.75V/cell	13.8V float
Power Sonic	PS-12280NB	28A-hr. 20 hours to 1.75V/cell	14.4V charge 13.8V float
Power Sonic	PS-12180NB	18A-hr. 20 hours to 1.75V/cell	14.4V charge 13.8V float
Cyclon	Various		Cyclon setting

It is not necessary to disconnect the solar panel to replace a battery. The SOLARPack will recognize an open-circuit or missing battery and adjust its operation automatically. Provided that the solar panel generates sufficient power to operate the device, all loads will remain powered.

CAUTION: When installing a battery pay close attention to the polarity of the wiring and battery terminals. Failure to make these connections properly may result in damage to the SOLARPack and the battery.

WARNING: The battery terminals must be a screw type connection, nut and bolt connection or permanently fixed to the battery by the battery manufacturer when the SOLARPack is installed in Class I, Division 2 hazardous locations.

5.4.2 Battery Type DIP Switch Settings

The Battery Type DIP Switch is located adjacent to the Battery connection terminal P6. The DIP switches are used to set the battery charger voltage and temperature compensation. Refer to ***Figure 5-6: Battery DIP Switch.*** The dip switch is shown in the AGM position with AGM voltage settings.

- Switch 1 is not used.
- Switch 2 is placed in the UP or ON position when Cyclon pure lead type batteries are used. Switch 2 is placed in the DOWN or OFF position when Gel or AGM valve regulated lead acid (VRLA) acid batteries are used.
- Switch 3 sets the charge voltage to either 14.4V or 13.8V. Switch 3 is placed in the UP or ON position to set the charge voltage to 14.4V. (14.4V is the charge voltage used by AGM batteries.) Switch 3 is placed in the DOWN or OFF position to set the charge voltage to 13.8V. (13.8V is the charge voltage used by Gel batteries.)
- Switch 4 sets the float voltage either 13.8V or 13.5V. Switch 4 is placed in the UP or ON position to set the float voltage to 13.8V. (13.8V is the float voltage used by AGM batteries.) Switch 4 is placed in the DOWN or OFF position to set the float voltage to 13.5V. (13.5V is the float voltage used by Gel batteries.)

Switches 3 and 4 are not used for Cyclon pure lead type batteries.

Note that these voltages are at 20ºC. The temperature compensation will provide lower voltages at higher temperatures and higher voltages at lower temperatures.

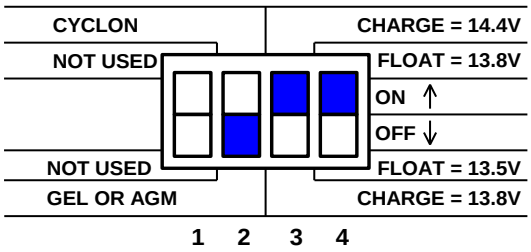


Figure 5-6: Battery DIP Switch

5.4.3 Battery Wiring

Two connections are made from the SOLARPack 410 main PCB connectors to the battery terminals as shown in ***Figure 5-7: Battery Wiring***. 14AWG red and black wires are supplied with ring terminal for this purpose. Select an alternate battery termination connection if the selected battery uses different terminations than the supplied wiring.

- Battery + (P6, 1): Connection to positive battery terminal.
- Battery – (P6, 2): Connection to negative battery terminal.

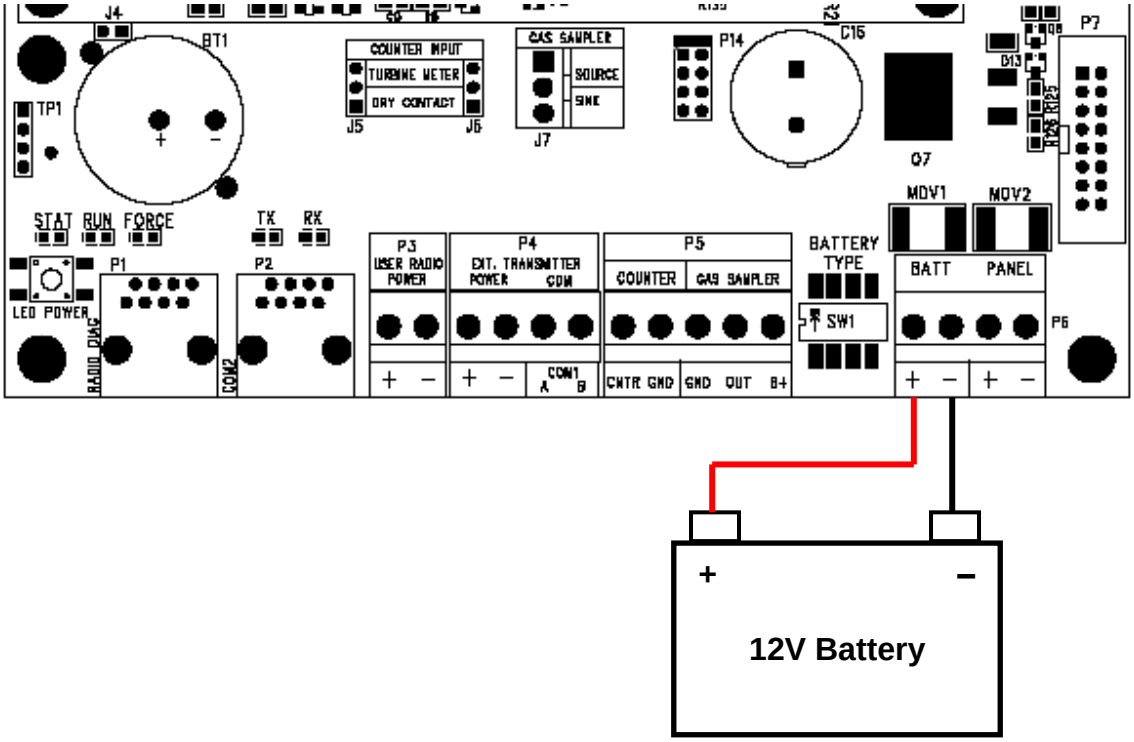


Figure 5-7: Battery Wiring

5.4.4 Battery Temperature Compensation

The SOLARPack adjusts charge and float voltages according to the temperature of the battery. A temperature sensor mounted on the SOLARPack 410 controller board provides accurate temperature measurement.

Voltages for lead-acid batteries are adjusted downwards by 32.5 mV for each degree Celsius above 20 degrees C, to a limit of 49 deg C. Voltages are adjusted upwards by 32.5 mV for each degree Celsius below 20 deg C, to a limit of -15 deg C.

Voltages for Cyclon batteries are adjusted downwards by 24 mV for each degree Celsius above 0 deg C, to a limit of 47 degree C. Voltages are adjusted upwards by 45.6 mV for each degree Celsius below 0 degrees C, to a limit of -40 deg C.

Charging voltage is precisely regulated and adjusted according to temperature. Failure of this sensor can cause over-charging, hydrogen gassing, and permanent damage to the battery. Once the temperature sensor responds correctly, this alarm will clear. If the temperature sensor fails during operation, the device will remember the last valid temperature provided by the sensor. If the temperature sensor is disconnected or faulty at reset, the device will use 68F/20C as the default temperature. Sustained operation with a missing or faulty temperature sensor should be avoided, especially at high ambient temperatures.

5.4.5 Charging States

The SOLARPack 410 uses a shunt regulator battery charger system. Battery charging is achieved by shunting the solar panel current away from the battery using a high frequency pulse width modulator. As a result, solar panel current is always flowing.

The state of the battery charging is indicated in the upper right corner of the LCD display. The charging sequence is as follows:

The SOLARPack 410 charger will first test for and determine the condition of the battery before proceeding with the charging stages.

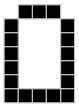
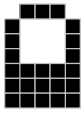
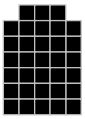
The charger then proceeds to bulk charge to replace the battery charge at the maximum rate of the solar panels. Most of the batteries charge replacement occurs during this stage. The battery is below the charge voltage and a current will be limited by the solar panel.

The second stage is the absorption stage. The battery is kept at the charge voltage and a current will be limited by the battery. This is the final stage of battery charge replacement.

The last stage will maintain the battery with the float voltage until the charger recognizes that additional charging is required and will revert back the charge voltage.

Every morning the condition of the batteries is determined and the charging sequence repeats beginning a battery test and continues on to the first charge stage.

Table 5-3 Battery LCD Indication

Display	Charging State
	Fault conditions. A battery fault has been detected or the battery is less than 10.5V.
	Normal conditions. The battery is charging or discharging normally or the battery is being tested in preparation for charging.
	Charging complete. The battery is completely charged and has entered the float charge state.

5.4.6 Battery Under Voltage Lockout

The SOLARPack 410 will detect low voltage inputs and enter a very low power consumption mode. This under voltage lockout (UVLO) situation is required to prevent excessive drain and eventual damage to the battery. The SOLARPack 410 enters UVLO at 9.5 V and returns to normal operation at 11.0V. There is approximately 1.5V of hysteresis.

5.4.7 Using an External Power Supply

Sometimes during development it is necessary to operate the SOLARPack without a battery or solar panels. This may be necessary in a lab or office environment for program development. It is important to observe the following precautions for the safety of the user and to prevent damage to the SOLARPack.

Connect a DC power supply to the BATT + and – connections on P6. The voltage must be 12 to 14Vdc. The current of this power supply must be sufficient for the loads in use. This can be done with or without a battery installed. If a battery is installed pay close attention to the voltage and current settings of the power supply to ensure that the battery is not being overcharged.

CAUTION:	**Never connect a power supply to solar panel terminals.** Only connect a solar panel to the PANEL + and – connections on P6.
CAUTION:	Use extreme caution when connecting an external power supply to the SOLARPack. Pay close attention to the polarity of all connections and voltages.

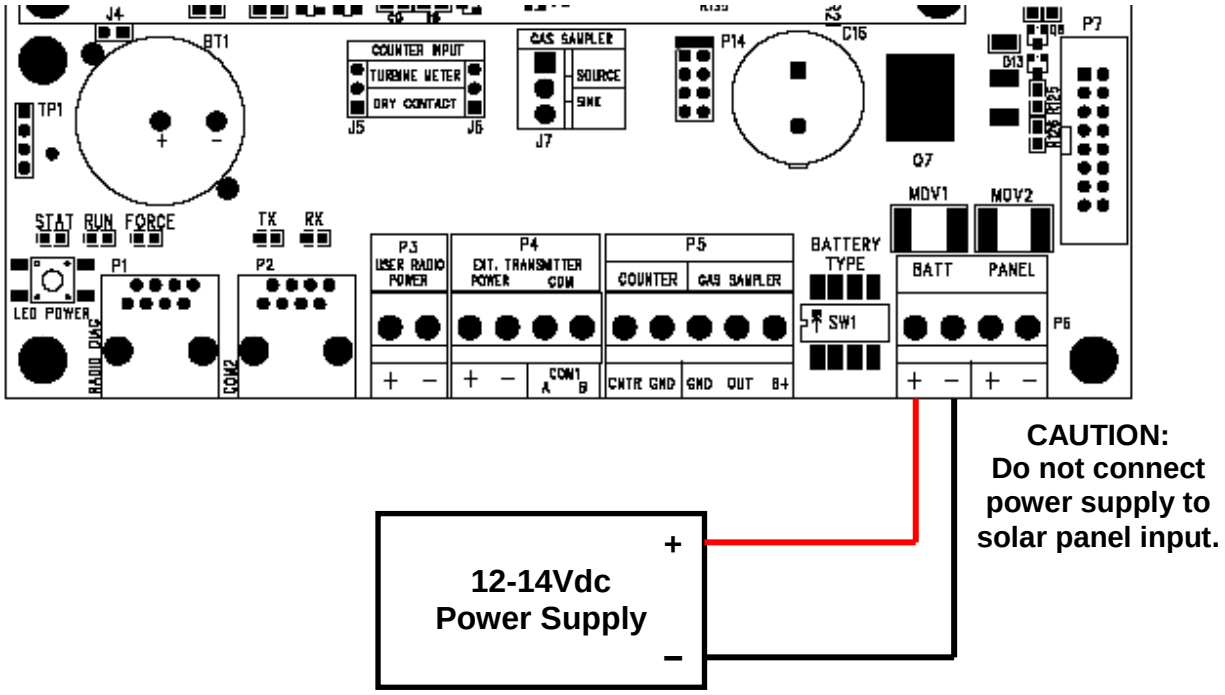


Figure 5-8: External Power Supply Operation

5.5 Solar Panel Selection

Solar Panels up to 32W designed for 12V battery systems can be used with the SOLARPack 410. The size of the solar panel depends on the amount of sunlight expected, the battery size and the number days of autonomy in the application.

CAUTION:	Do not use solar panels greater than 32W and 25V. Damage to the SOLARPack may result.

Refer to ***Table 5-4: Solar Panel Selection*** for a list of solar panels suitable for use with the SOLARPack 410. Similar panels from other manufacturers may also be used.

CAUTION:	The following solar panels were not part of the SOLARPack 410 hazardous locations certification. Solar panels must be installed and acceptable for use in Cl. 1, Div. 2 hazardous areas as per the CEC and NEC.

Table 5-4: Solar Panel Selection

Manufacturer	Model Number	CMI Part Number	Maximum Power	V (open circuit), I (short circuit)
BP Solar	BP SX5M	308195	4.5W (16.5V at 0.27A)	20.5V, 0.3A
BP Solar	BP SX10M	308196	10W (16.8V at 0.59A)	21.0V, 0.7A
BP Solar	SX-30U		30W (16.8V at 1.78A)	21.0V, 1.94A
BP Solar	SX-20U		20W (16.8V at 1.19A)	21.0V, 1.29A
Carmanah	CTI-11J	308121	11W (17.4V at 0.63A)	22.0V, 0.65A
Carmanah	CTI-21J	308122	22W (17.4V at 1.26A)	22.0V, 1.3A
Carmanah	CTI-32J	308123	32W (17.4V at 1.85A)	22.0V, 1.95A

5.5.1 Solar Panel Wiring

Do not connect a power supply to the Solar Panel power input on connector P6. This input is intended for solar panels only. If it is necessary to operate the SOLARPack 410 from a power supply, refer to ***5.4.7 Using an External Power Supply*** section of this manual.

CAUTION:	Do not connect a power supply to the Solar Panel power input on connector P6. Connecting to a power supply to the Solar Panel input may result in damage to the power supply and SOLARPack. 410.

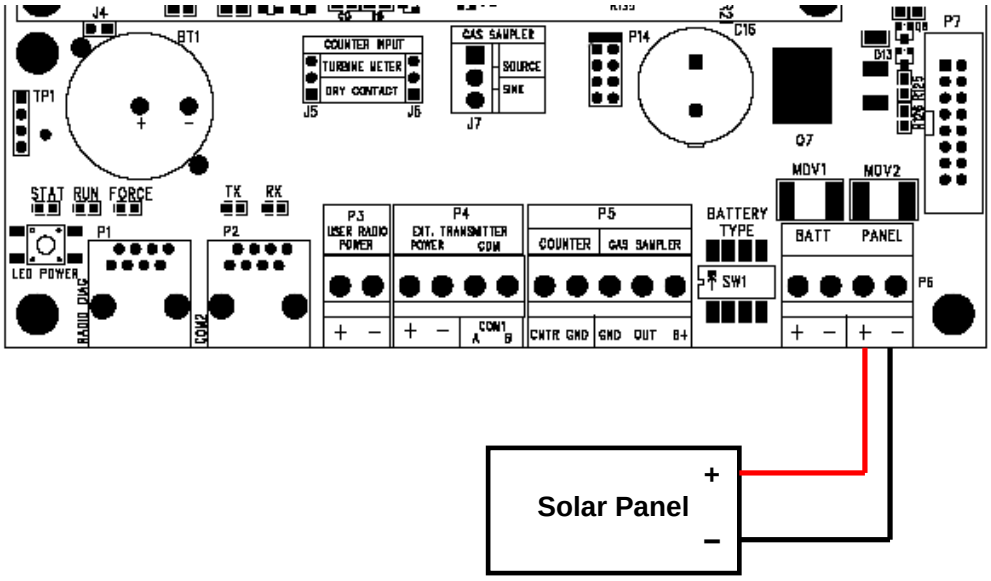


Figure 5-9: Solar Panel Wiring

5.6 RTD Wiring

The wiring of the Resistance Temperature Detector (RTD) will depend on the SOLARPack 410 model. For the Internal Sensor version the RTD is wired to the Sensor Interface board. For the Remote Sensor version the RTD is wired to the SCADASense 4102 (with external sensor firmware).

5.6.1 Internal Sensor Version

Figure 5-10: RTD Wiring Examples shows how to wire 3 and 4 wire RTDs. The RTD connections are located on the Sensor Interface board. See ***Figure 4-8: Sensor Interface.***

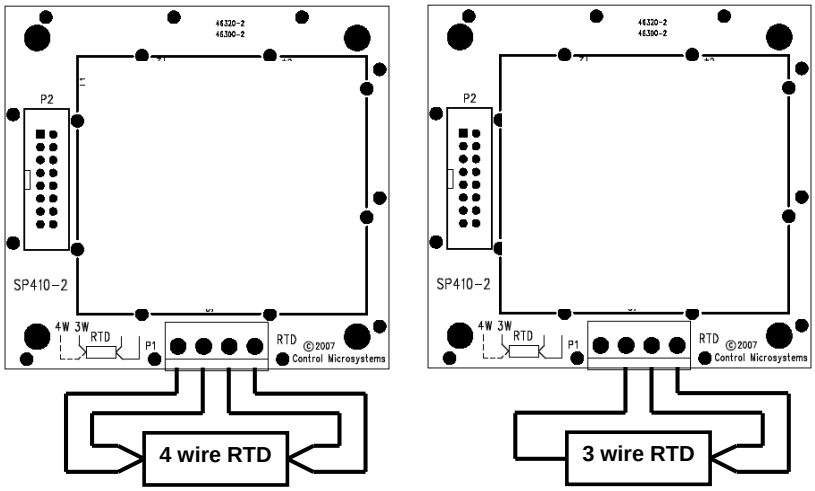


Figure 5-10: RTD Wiring Examples

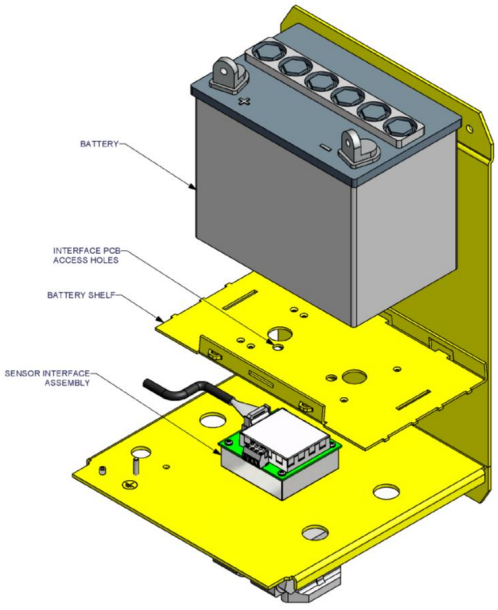


Figure 5-11: Sensor Interface

5.6.2 Remote Sensor Version

Refer to the SCADASense 4102 Hardware Manual for information on wiring the RTD and process connections. The Remote Sensor version of the SOLARPack requires a SCADASense 4102 configured with Remote Sensor Firmware.

Figure 5-12: SOLARPack 410 to SCADASense 4102 Wiring shows the power and communications wiring from the SOLARPack 410 to the SCADASense 4102. Refer to the SCADASense 4102 manual for additional wiring information for RTD wiring.

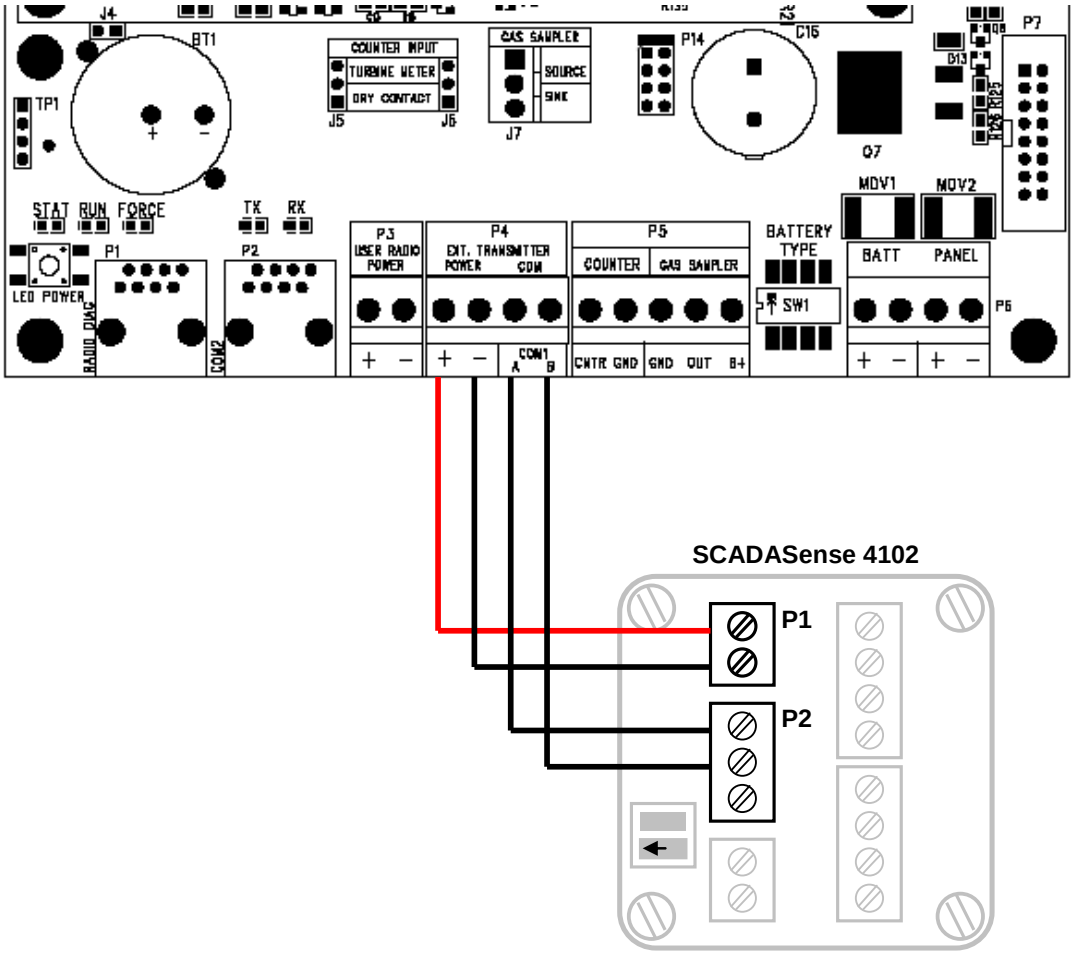


Figure 5-12: SOLARPack 410 to SCADASense 4102 Wiring

5.7 FreeWave 900 MHz Spread Spectrum Transceiver

The FreeWave FGR09CSU MHz Spread Spectrum Wireless Transceiver is the optional radios that may be supplied with the SOLARPack 410.

The FreeWave transceiver is power from the system power supply (13.5V nominal) that is integrated into the SOLARPack 410.

The FreeWave transceiver has two communication ports.

- The main communication port must be configured for RS-232 signal levels. This port is wired as part of the FreeWave Transceiver integration and requires no further connection from the user.
- The diagnostics communication port is configured for RS-232 signal levels. This port is connected to the Radio Diagnostic (P1) connector.

5.7.1 Radio Diagnostics Port

The RADIO DIAG (P1) port is connected to the internal radio diagnostics connector. This port is used to configure the FreeWave transceiver.

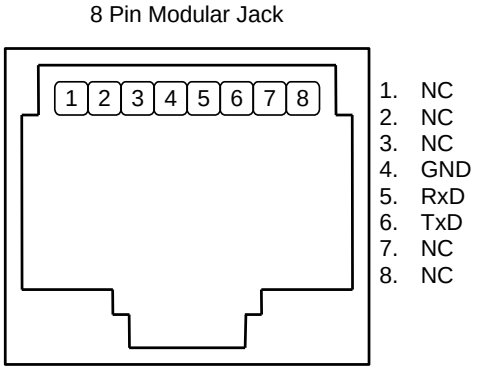


Figure 5-13 Radio Diagnostics Modular Jack Connector (P1) Pinout

Table 5-5 RS-232 P1 (Radio Diagnostics) Connector

RS-232 P2	Function and comments
1	No connection.
2	No connection.
3	No connection.
4	Ground.
5	RxD - Input to the FreeWave radio diagnostics port.
6	TxD - Output from the FreeWave radio diagnostics port.
7	No connection.
8	No connection.

5.7.2 Radio Setup Jumper (J1)

The **Radio Setup** jumper (J1) provides a simple method to enter the FreeWave transceiver configuration mode. When in this mode the radio can be configured for your application. See the section ***5.7.3.1 Radio Module Setup Program*** for details on using EZ Config software.

To enter the setup mode:

- Connect a PC that is running EZ Config to the RADIO DIAG port on the SOLARPack 410.
- Connect a jumper wire to short the RADIO SETUP pins together.
- Remove the jumper from the RADIO SETUP pins.
- Use EZ Config to set up the FreeWave transceiver.

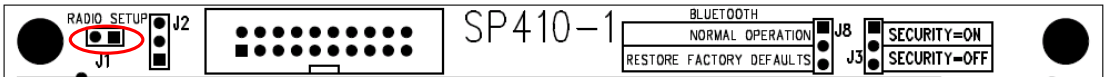


Figure 5-14: Radio Setup Jumper (J1) Location

5.7.3 FreeWave Radio Module Configuration

The typical installation for a FreeWave transceiver is in a point to multipoint configuration. In this configuration a single master transceiver communicates with a number of slave transceivers. The user is encouraged to thoroughly read the ***Multipoint Operation*** section of the ***FreeWave Spread Spectrum Wireless Data Transceiver User Manual*** for complete information on using Multipoint systems.

It is recommended that the following steps be used to configure the Radio Modules in your network.

- Open the Radio Module Setup program.
- Set the Operation Mode for the master and slave Radio Modules.
- Set the Baud Rate for the main communication port (internally connected to the SOLARPack 410 COM2 port).
- Set the Radio Transmission Characteristics.
- Set the Multipoint Parameters.

5.7.3.1 Radio Module Setup Program

The FreeWave transceiver is programmed using EZConfig software. This software is available on the Configuration CD that was shipped with the SOLARPack 410.

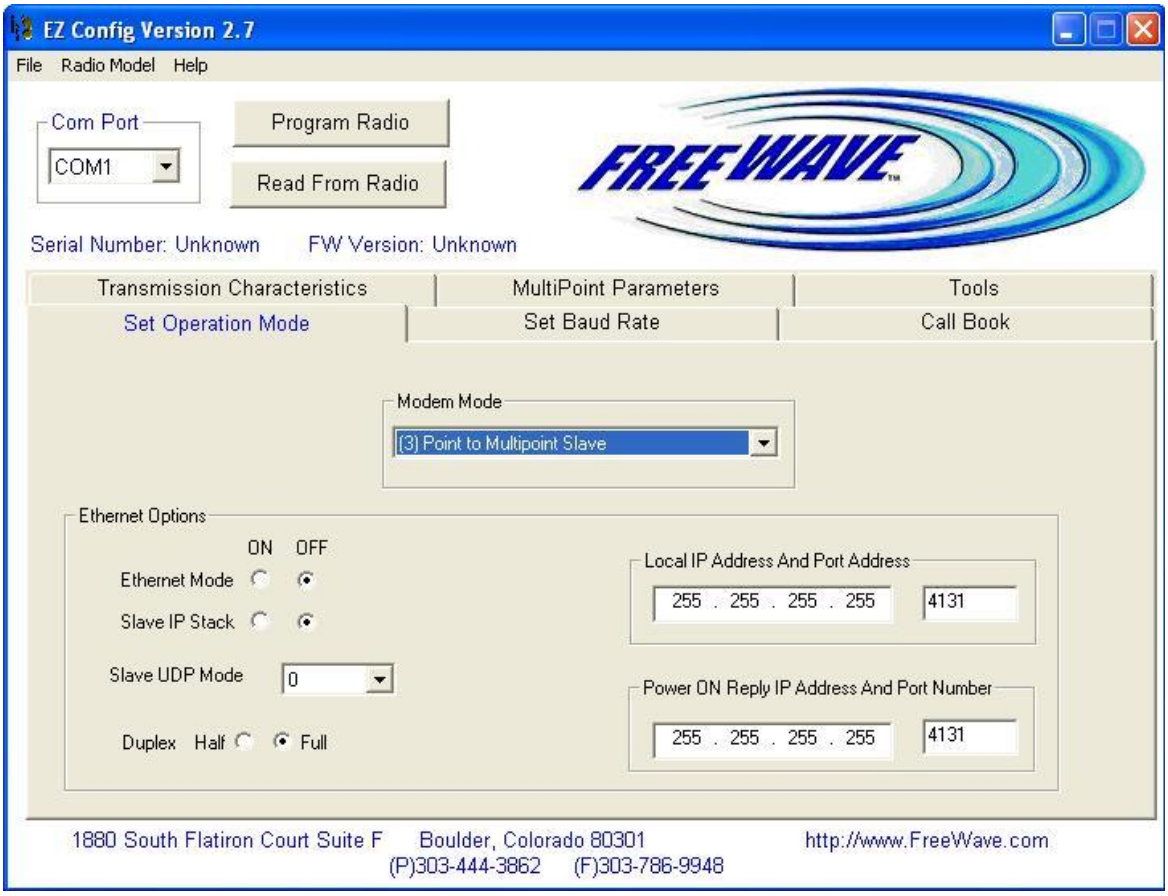
EZ Config is a Windows-based program which allows you to set up a configuration offline, then download it into a radio when desired. You may save the configuration for later use. You may also upload a configuration from a radio, and then save it as a file.

To use EZ Config, first open the program and connect a null cable to the RADIO DIAG port (P1). In the upper left of the screen, select the com port you are using on your computer.

Click the ***Read From Radio*** button to upload whatever configuration is currently in the radio. If the connection is not successful check your cable, the Port Settings in EZ Config, and ensure that the port is not in use by other software. Once you have read the radio's configuration, click File, Save Radio File if you wish to keep a backup copy of the existing setup.

Check each of the four configuration tabs, and see how the radio is configured. Make any necessary changes and click the ***Program Radio*** button. Save your new configuration by clicking File, Save Radio File before you exit from the program.

5.7.3.2 Set Operation Mode



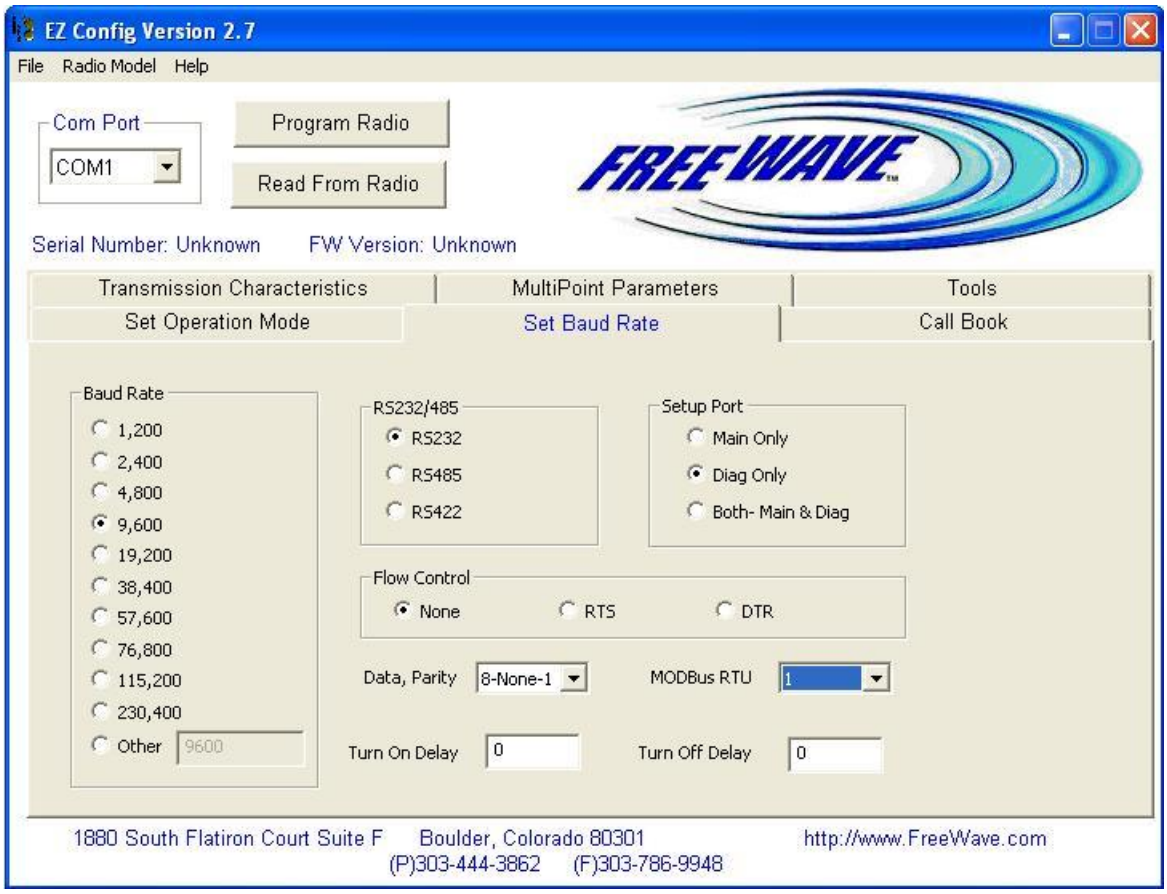
Modem Mode: Select option (2) – Point to Multipoint Master in the master radio.

Select option (3) – Point to Multipoint Slave in the slave radio

Select option (7) – Point to Multipoint Repeater if using as a repeater

Note: If the unit is to be used as both a repeater and a slave, also turn on Slave/Repeater in Multipoint Parameters. Leave the Ethernet Options turned off as these are not available.

5.7.3.3 Set Baud Rate



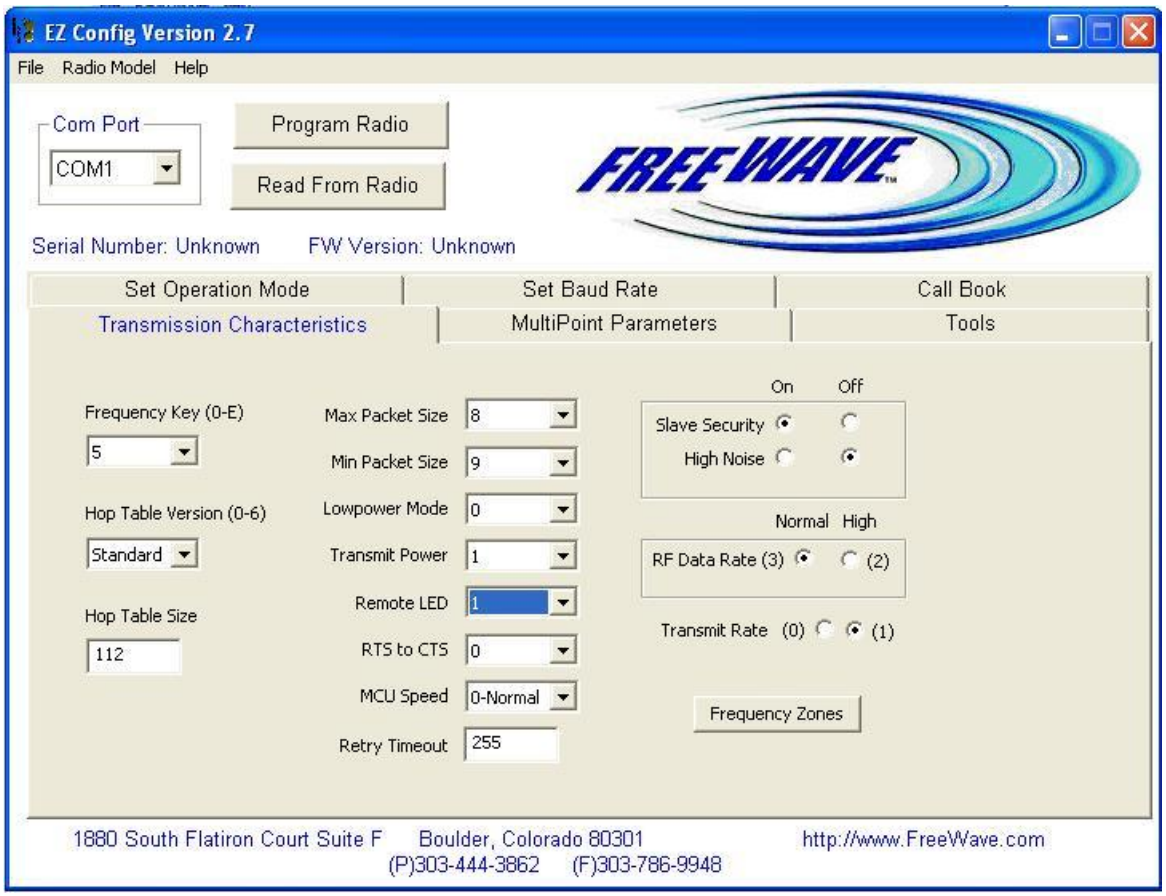
Baud Rate: Select the baud rate that will be used between the radio and the controller to which it is connected by serial port. This is NOT the over-the-air rate. Each radio may be set to a different rate, so long as it matches the attached device.

Setup Port: Sets which port is used for programming the radio. It is not recommended to attempt programming through the COM port. Typically set to Diag Only. If accidentally set to Main Only (COM port), the procedure in **SETUP** on page 1 will need to be followed to communicate with the radio for programming.

Flow Control: Set as required for the COM port connection.

Modbus RTU: Set to 1 if using the Modbus RTU protocol on the COM port. This specifies that Modbus packets will always be sent in one hop, to avoid comm fails due to incorrect end-of-message timeouts.

5.7.3.4 Transmission Characteristics



Frequency Key: Hop pattern. Select a value that will the same for all radios in this system. The Key must be different from that used by other systems in your area. Change from the default!!

Transmit Power: Set to 1 or 0 for bench testing. Adjust depending on the distance between the master and slave. 10 equals full output of 1 watt, and 0 equals 5 milliwatts. Setting transmit power too high may cause distortion in nearby radio receivers.

High Noise: Turn on to reduce receiver sensitivity. Use at sites very near the master, when the master's transmit power can not be reduced, or where other radios are interfering.

Remote LED: Will turn the LED's on or off – set them on unless in a very low-power system.

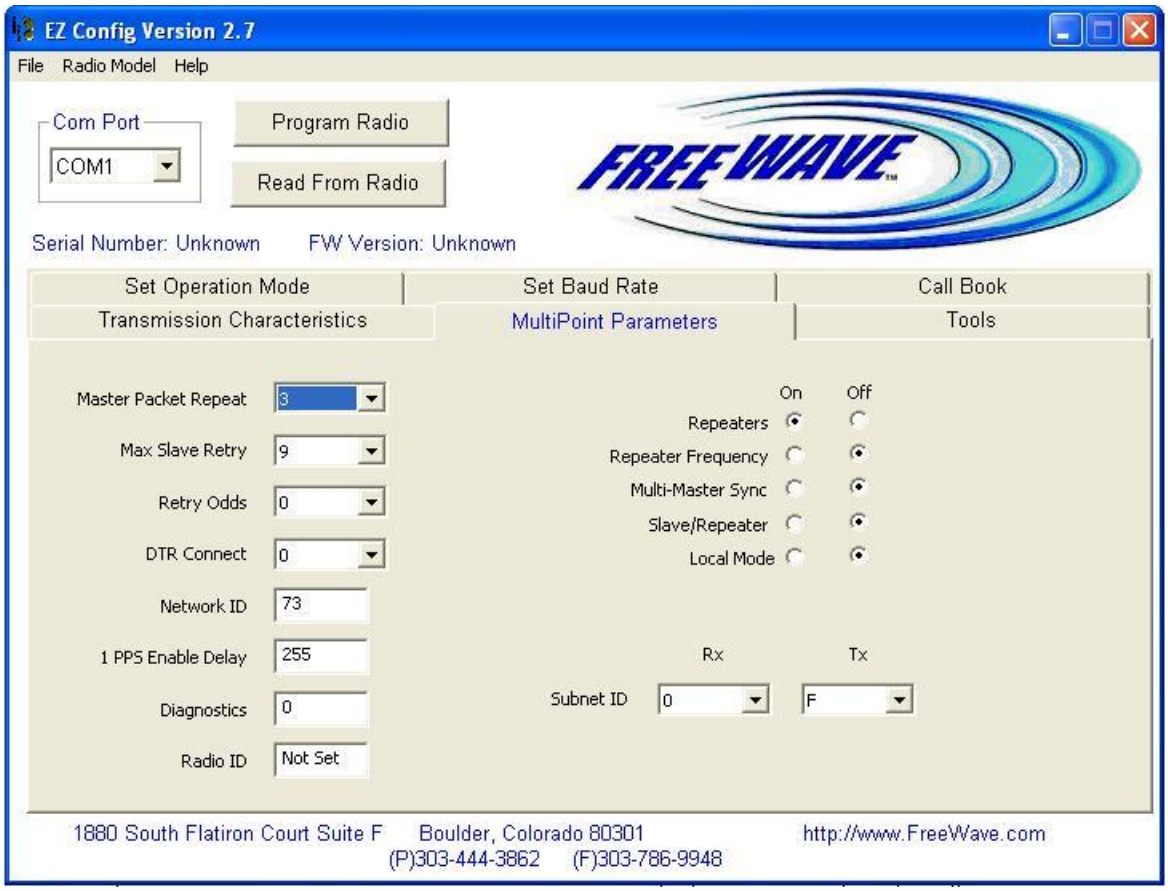
Max Packet Size: Refers to a look-up table in the FreeWave manual which specifies the largest master message size allowed. (Must be same in all radios in the system)

Min Packet Size: Refers to a look-up table in the FreeWave manual which specifies the smallest number of bytes a slave will get in each time slice. (must be same in all radios in the system)

Note: Max and Min Packet Size are typically used to change the hop speed of the radio network. Smaller values allow a faster hop speed. Faster hops reduce interference problems, and also reduce chances of conflicts with other systems nearby.

(Values of 2 or less will reduce system efficiency)

5.7.3.5 Multipoint Parameters



Retry Odds: Set to 0 to disable automatic pseudo-random retries after maximum number of retries has expired. The packet is lost, but this prevents multiple collisions and possible system lockup after the master radio is turned on.

Network ID: Must be changed from the default value of 255. All radios must be the same.

Repeaters: Must be set to On in all radios if there are any repeaters in the system, telling master to pause every 2nd time slice to give repeaters time to pass data forward. May be set to Off otherwise, though it will not cause problems if left on.

Slave/Repeater: Turn On only if the radio is in use both as a repeater and a slave. (Must be in mode 7 - Point to Multipoint Repeater in this case)

Subnet ID: Always set to Rx = 0 and Tx = 0 in the Master. If no repeaters are used then in the Slaves set to Rx = 0 and Tx = F. Rx Subnet ID of a slave or repeater must always match the Tx Subnet ID of the radio upstream from it. (tells it to sync to that radio's hop pattern)

5.8 User Supplied Radios

The SOLARPack 410 has both the physical space in the enclosure and power supply capacity to accommodate user supplied radios.

5.8.1 User Supplied Radio Mounting

The user supplied radio can be mounted either on the battery shelf next to the battery of secured to the underside of the battery shelf. In both cases it is the users' responsibility to secure the radio from vibration if required by the application.

The battery shelf has several countersunk holes suitable for #4 screws that are compatible with some commercially available radios and their mounting brackets.

5.8.2 User Supplied Radio Wiring

The user is responsible for wiring the communications, power and antenna.

CAUTION:	Do not connect/disconnect SOLARPack 410 wiring unless the area is known to be non hazardous.

RS-232 communications are provided on P2 (COM2). When an RS-232 device such as a laptop computer is connected to the P2 connector the interface to the internal radio is disabled and the RS-232 device connected at P2 (COM2) is connected to the SOLARPack 410 COM2.

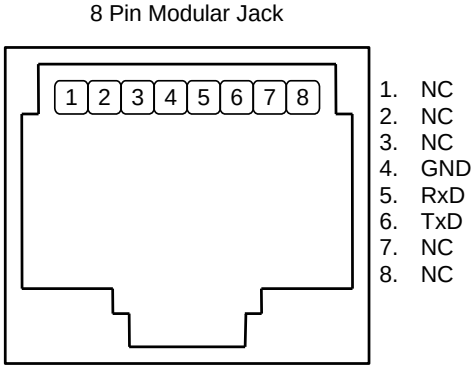


Figure 5-15 COM2 Modular Jack Connector (P2) Pinout

Table 5-6 RS-232 P2 (COM2) Connector

RS-232 P2	Function and comments
1	No connection.
2	No connection.
3	No connection.
4	Ground.
5	RxD - Input to SOLARPack 410 from RS-232 radio.
6	TxD - Output to RS-232 radio from SOLARPack 410.
7	No connection.
8	No connection.

The user supplied radio is powered by the system voltage (battery voltage, nominally 13.5Vdc) and is available on terminal block P3. The power is switched by the SOLARPack 410 controller under the control of the application program to minimize power consumption. Refer to ***Figure 5-16: User supplied radio wiring*** for wiring details.

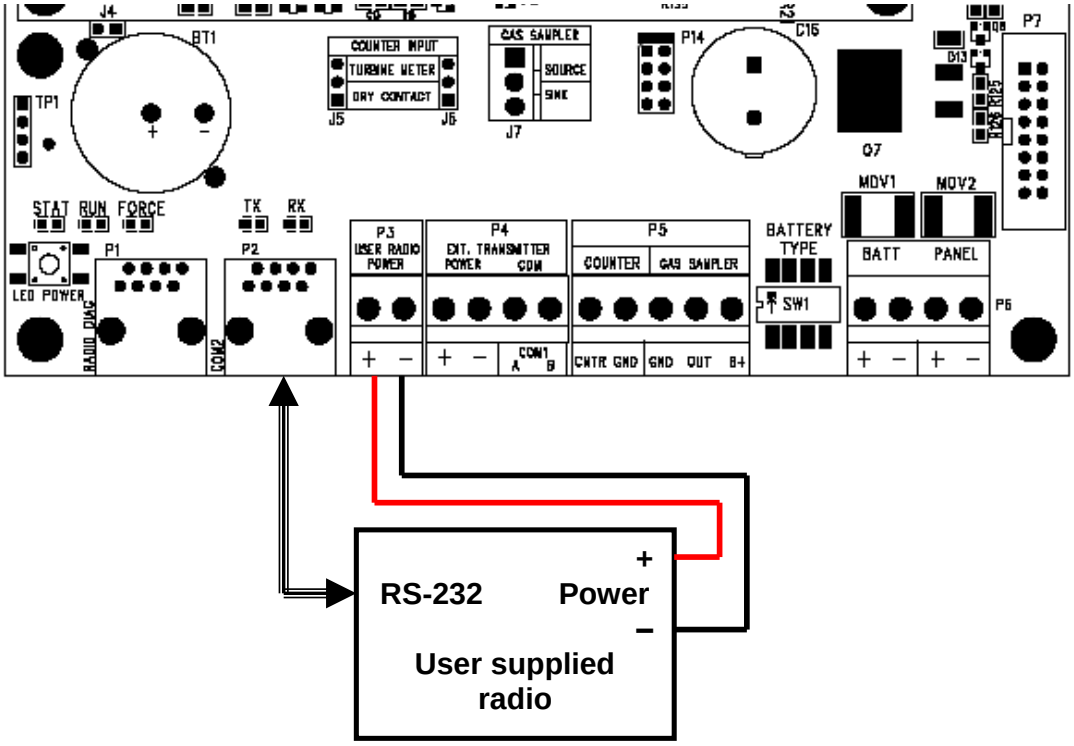


Figure 5-16: User supplied radio wiring

5.9 Counter Input

The SOLARPack 410 has a single counter input designed for millivolt level turbine meters. RealFLO is used to configure the counter input for Units and K Factor. See the section ***5.9.3 - Pulse Input RealFLO Configuration*** for RealFLO configuration details.

There are two jumper links positions: J5 and J6, associated with configuring the turbine meter counter inputs for either millivolt signals (direct to sensor) or high level signals from turbine meters with external amplifiers, dry contacts or open collector outputs.

5.9.1 Turbine Meter Counter Input

When connecting a low voltage (millivolt) turbine meter directly to counter input, enable the SOLARPack 410 internal pre-amplifier on this input by installing a pair of jumper links in the upper or "Turbine Meter" positions of J5 and J6.

5.9.1.1 Turbine Meter Counter Wiring

See ***Figure 5-17: Turbine Meter Input Wiring*** for a wiring diagram of a turbine meter input. Note the use of shielded wiring.

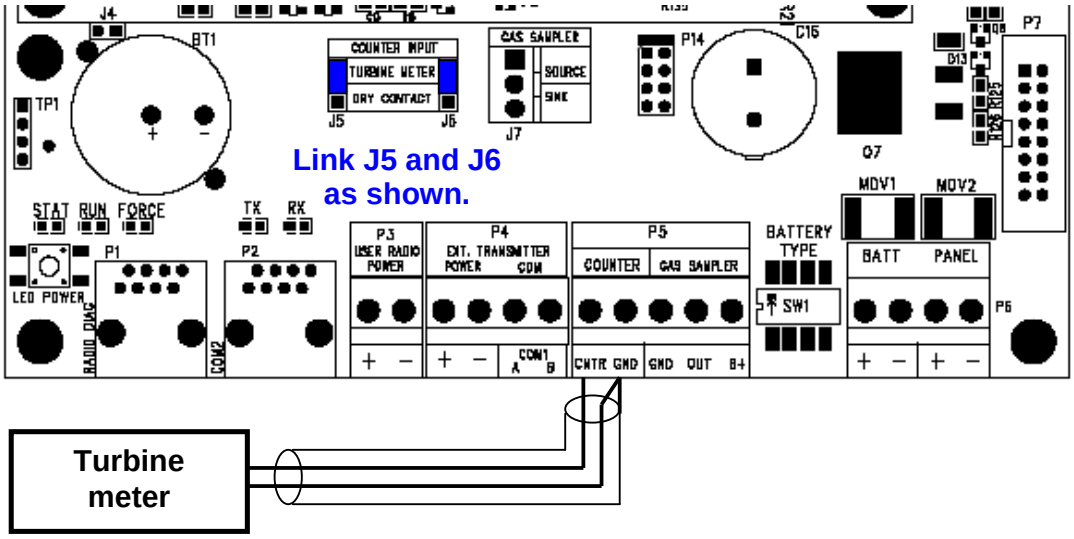


Figure 5-17: Turbine Meter Input Wiring

5.9.2 Dry Contact Counter Input

The counter input can also be configured for use with a turbine meter featuring an integrated or standalone amplifier. In this configuration, the SOLARPack 410 internal amplifiers must be bypassed by installing a pair of jumper links in the lower or "Dry Contact" positions of J5 and J6. Most mechanical switches, relay contacts, MOSFETs and transistors can be detected in this configuration.

Your standalone amplifier may have a specific current requirement as specified by the manufacturer. As shown in the figure above, the SOLARPack 410 includes a 2000-ohm resistor from the counter input to the system (battery) voltage, providing 6mA when the jumpers J5 and J6 are installed in the 'Dry Contact' position, as described above. The above configuration is the recommended wiring for a Halliburton Low Power Pre-Amp with a SOLARPack 410 and a nominal 13.5V battery voltage.

If your amplifier requires a current greater than 6mA, jumper J5 should not be installed in either position, while J6 should remain installed as shown in ***Figure 5-19: Dry Contact Counter wiring with external pullup resistor.*** The appropriate external pull-up resistor should be connected between the counter input and the system (battery) voltage.

5.9.2.1 Dry Contact Counter Wiring

See ***Figure 5-18: Dry Contact Counter Wiring*** for a wiring diagram of a dry contact output.

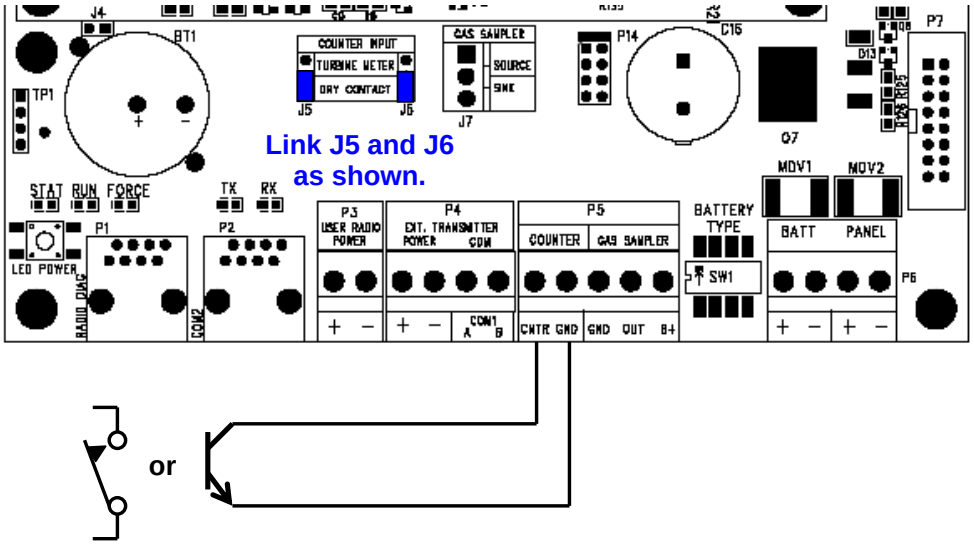


Figure 5-18: Dry Contact Counter Wiring

See ***Figure 5-19: Dry Contact Counter wiring with external pullup resistor*** for a wiring diagram of a dry contact output requiring additional current. The pullup resistor is shown connected to the system (battery) voltage.

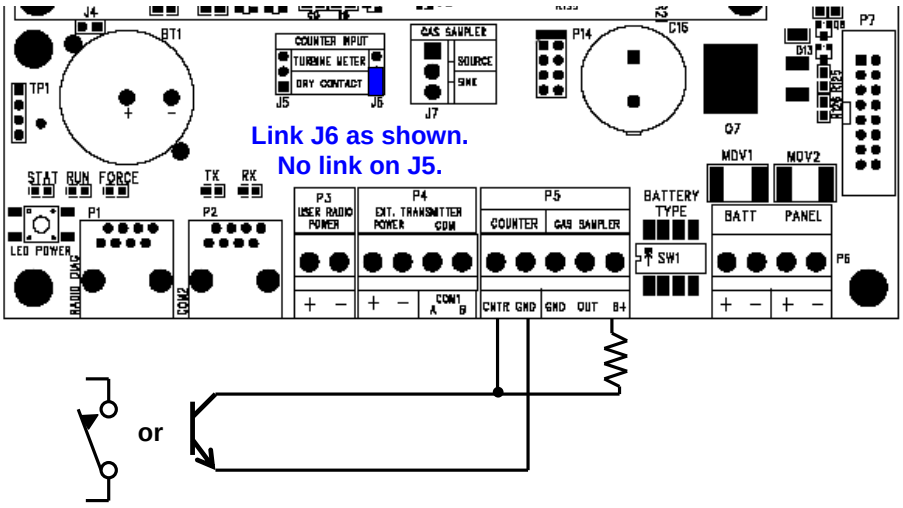


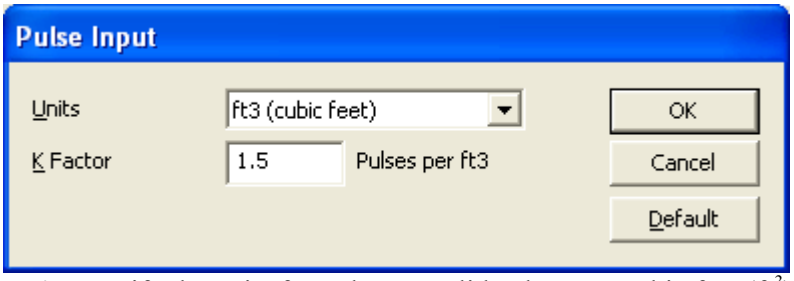
Figure 5-19: Dry Contact Counter wiring with external pullup resistor

5.9.3 Pulse Input RealFLO Configuration

The Pulse Input is configured using RealFLO. With RealFLO open:

- Select the **Pulse Input** command on the **Configuration** menu to open the Pulse Input configuration dialog.

The Pulse Input Configuration dialog appears as follows.



Units specify the units for volume. Valid values are cubic feet (ft^3) and cubic meters (m^3), liters, and US gallons, barrels (42 US gallons). The default value is cubic feet.

K Factor specifies the factor by which the raw count is divided to obtain the volume. Valid values are any number greater than 0. The default value is 1.0. Units are pulses/volume.

5.10 Gas Sampler Output

The gas sampler output operates a device – typically a valve – to sample gas at a defined rate. The output is a pulse of 0.1 seconds to 5 seconds wide. The resolution is 0.1 seconds.

The gas sampler output can be configured as a sourcing or sinking output. Refer to section ***5.10.2 Gas Sampler Output RealFLO*** Configuration for configuration of the gas sampler pulse durations.

A sourcing output has the load connected to the -ve side of the power supply and a +ve gas sampler pulse is generated by the SOLARPack 410 and is available on the P5-4 terminal. The wire link on connector J7 is between terminals 1 and 2. See ***Figure 5-20: Gas Sampler Sourcing Output.***

A sinking output has the load connected to a +ve side of a power supply and a -ve (sinking) gas sampler pulse is generated by the SOLARPack 410 and is available on the P5-4 terminal. The wie link on header J7 is between terminals 2 and 3. See ***Figure 5-21: Gas Sampler Sinking Output***.

5.10.1 Gas Sampler Output Wiring

See ***Figure 5-20: Gas Sampler Sourcing Output*** for a wiring diagram of a sourcing output. A sourcing output provides a closing switch between P5, 5 (B+) and P5, 4 (OUT). The gas sampler load is connected to the system common or -ve side of the battery. The gas sampler output is short circuit protected.

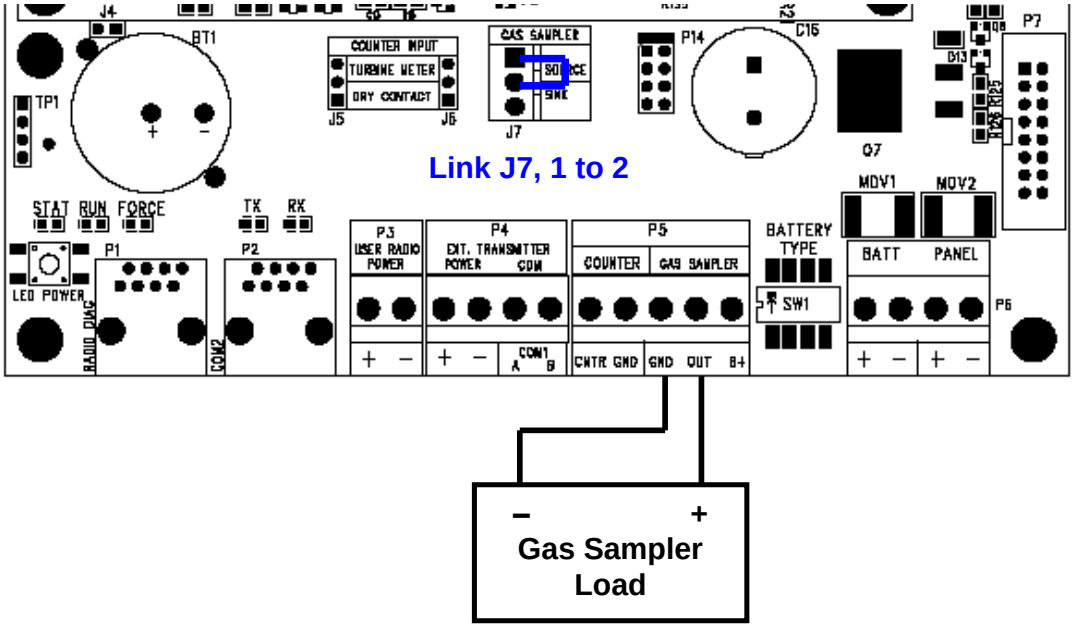


Figure 5-20: Gas Sampler Sourcing Output

See ***Figure 5-21: Gas Sampler Sinking Output*** for a wiring diagram of a sinking output. A sinking output provides a closing switch between P5, 4 (OUT) and P5, 3 (GND).

The gas sampler output is short circuit protected. Note that the +ve side of the gas sampler load can be connected to other +ve power supplies that may be available. The B+ terminal is connected to the battery and is provided as a wiring convenience to the user.

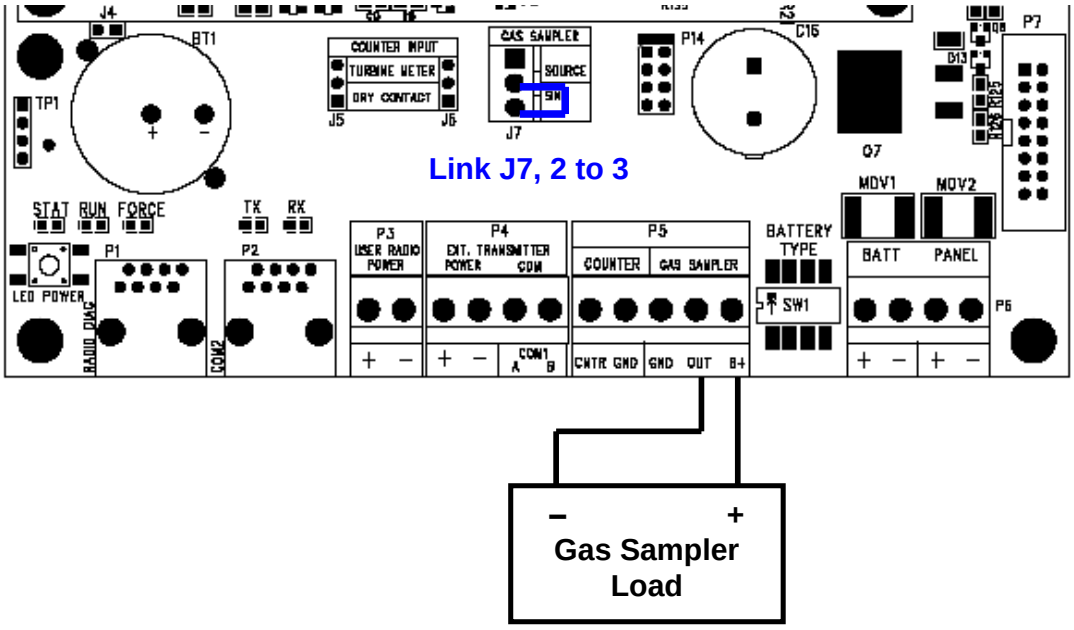


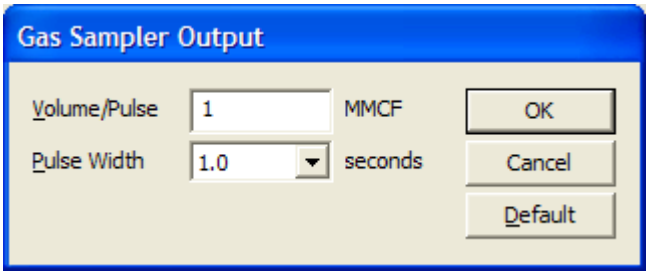
Figure 5-21: Gas Sampler Sinking Output

5.10.2 Gas Sampler Output RealFLO Configuration

The Gas Sampler Output is configured using RealFLO. With RealFLO open:

- Select the **Gas Sampler Output** command on the **Configuration** menu to open the Gas Sampler Output configuration dialog.

The Gas Sampler Output dialog appears as follows.



Volume/Pulse specifies the flow volume for each pulse output. The measurement units are the same as the contract units for run 1. Any positive value is valid. The default value is 1,000,000 ft^3/pulse or the equivalent in the current unit set.

Pulse Width specifies the pulse width. Valid values are 0.1 to 5.0 seconds in increments of 0.1 seconds. The default value is 1.0 seconds.

6 SOLARPack 410 Operation

6.1 Operating Modes

The SOLARPack 410 may start up in Run, Service, Sensor or Cold Boot mode. Start up in the RUN mode automatically executes the RealFLO flow computer C application. Start up in the Service mode stops the RealFLO flow computer C application to allow reprogramming and controller initialization. Start up in the COLD BOOT mode initializes the SOLARPack 410 and erases the RealFLO flow computer C application.

6.1.1 Run Mode

RUN mode is the normal operating mode of the SOLARPack 410. Ensure the LED POWER push button is not pushed when power is applied to start Run mode operation. When power is applied to the SOLARPack 410:

- The user defined serial communication parameters, for all COM ports are used.
- The RealFLO flow computer C application program is loaded in RAM and the program checksum is correct, it is executed.
- The SOLARPack 410 Power management and *Bluetooth* security settings are used.

6.1.2 Service Mode

Service mode is used during application programming and maintenance work. When the SOLARPack 410 is started in Service mode:

- The default serial communication parameters are used (see section ***5.1- Communication Ports*** for a description of the default parameters).
- The Sensor driver is installed on Com 1. Com 1 is set to Sensor protocol, 19200 Baud, no parity, 8 data bits and one stop bit.
- The RealFLO flow computer C application program is stopped.
- The SOLARPack 410 Power management and *Bluetooth* security settings are used.

6.1.2.1 Service Boot

Service mode is selected by performing a **Service Boot** using the following procedure:

1. Remove power from the SOLARPack 410.
2. Push and hold the LED POWER button down.
3. Apply power to the controller.
4. Continue holding the LED POWER push button down until the STAT led turns on solid. This will take about 3 seconds.
5. Release the LED POWER push button.
6. The Service Boot remains in effect until the SOLARPack 410 is reset.

Note:	If the LED POWER push button is released before the STAT led turns on, the controller will start in RUN mode.

6.1.3 Sensor Mode

The Sensor Mode allows direct communication with the sensor electronics. This mode is provided to allow use of applications and tools that must communicate directly with the sensor electronics. When the controller starts in Sensor mode:

- The com1 and com2 serial ports operate at 4800 baud, no parity, 8 data bits, and one stop bit.
- The com3 serial port does not function.
- Sensor messages received on com2 are transmitted on com1 with the initial FF removed. Sensor messages received on com1 are transmitted on com2. Sensor timing restrictions are observed when transmitting. In effect, the transmitter is acting as a repeater.
- The RealFLO flow computer C application program is stopped.
- No other SOLARPack 410 features are available.

6.1.3.1 Sensor Boot

Sensor mode is selected by performing a **Sensor Boot** using the following procedure:

1. Remove power from the SOLARPack 410.
2. Push and hold the LED POWER push button down.
3. Apply power to the controller.
4. A Sensor boot occurs when the LED POWER push button is pushed and held for between 15 and 30 seconds. The STAT led blinks rapidly after 15 seconds to indicate the Sensor boot mode is selected.
5. The STAT led will blink short, short, long while the controller is in the Sensor mode.
6. The Sensor Boot remains in effect until the SOLARPack 410 is reset.

Note:	If the Cold Boot push button is released before the STAT LED starts to blink rapidly the controller will start in Service mode.

6.1.4 Cold Boot Mode

Cold Boot mode is used after installing new SOLARPack 410 firmware or when it is desirable to initialize the SOLARPack 410 to its default state. When the SOLARPack 410 starts in Cold Boot mode:

- The default serial communication parameters are used (see section *5.1- Communication Ports* for a description of the default parameters).
- The Sensor driver is installed on com1. Com1 serial port parameters are set to 4800-baud, no parity, 8 data bits, and one stop bit.
- The RealFLO flow computer C application program is erased.
- The SOLARPack 410 is unlocked.

6.1.4.1 Cold Boot

Cold Boot mode is selected by performing a **Cold Boot** using the following procedure:

1. Remove power from the SOLARPack 410.
2. Push and hold the LED POWER push button down.
3. Apply power to the controller.

4. A Cold Boot occurs when the LED POWER push button is pushed and held for more than 30 seconds. The STAT LED blinks slowly after 30 seconds to indicate the Cold Boot mode is selected.

Note: If the Cold Boot push button is released before the STAT LED starts to blink slowly the controller will start in Sensor mode.

6.2 Power Management

The flow computer manages power to components of the SOLARPack 410 to provide optimal power consumption.

The flow computer has two operating modes: power saving mode and continuous power mode.

In the **power saving mode**, the flow computer wakes up once per second and perform flow calculations. The Bluetooth radio, the telemetry radio, the display, and the backlight are turned off. This is the typical operating mode. In this mode the flow computer should run for approximately 110 ms each second, on average, to meet the target power consumption target.

In the **continuous power mode**, the flow computer remains powered for a period. Bluetooth radio, the telemetry radio, the display, and the display backlight are enabled according to the power management configuration.

The default mode for a flow computer that has not been configured is the continuous power mode, with all power enabled. This permits configuring a new flow computer over any interface. A sample configuration will be loaded in the factory with a suitable configuration for customers, which may select a different starting point.

The flow computer extends the wake time when communication is active. This prevents loss of communication and annoyance to operators, while allowing the wake times to be set as short as practical to conserve power.

- After a valid message is received on any communication port, the flow computer remains awake for a minimum of 2 minutes.

The maximum additional time the flow computer will stay awake is 40 minutes

6.2.1 Power Management Configuration

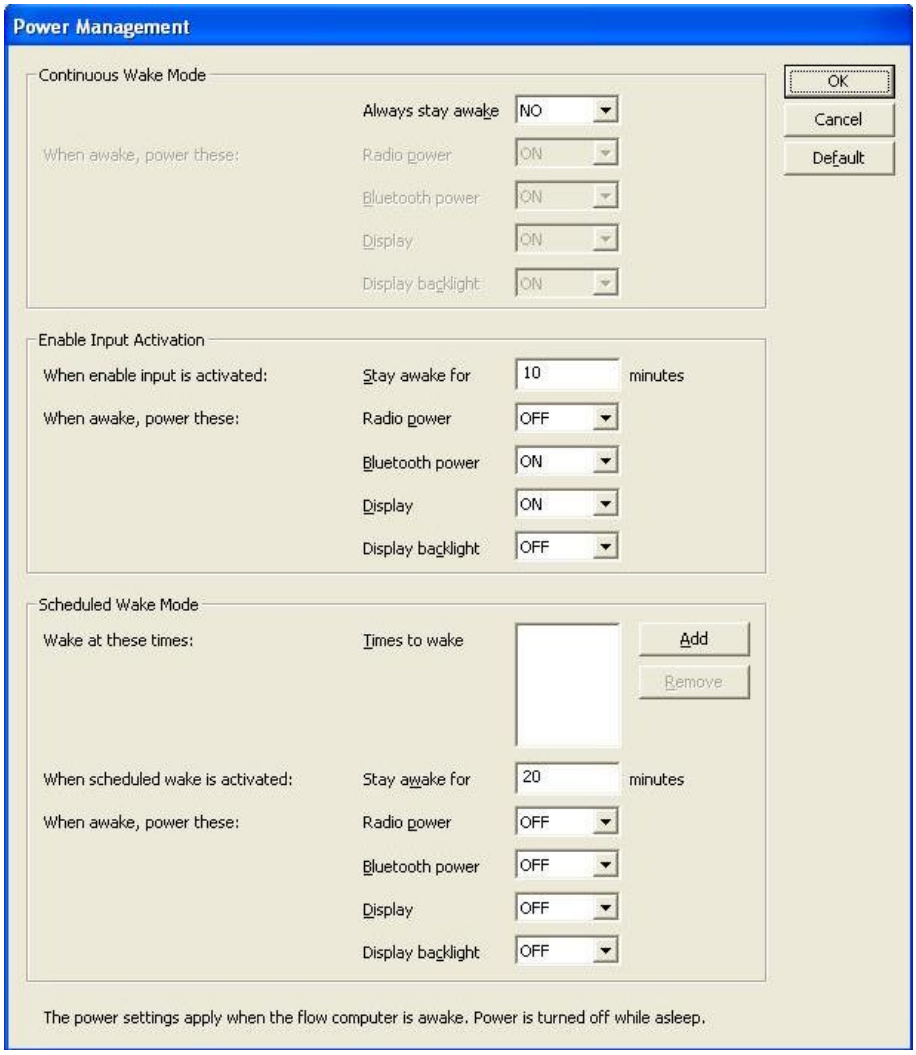
The SOLARPack 410 provides for operator control of the power management features of the SOLARPack 410. All configurations of the power management features are done using RealFLO. Power management provides control over power to these parts of the SOLARPack 410 to minimize the power consumption.

- Radio power
- Bluetooth power
- Display power
- Display backlight

All power management functions are programmed using RealFLO. To open the Power Management control in RealFLO:

- Select the **Power Management** command on the **Configuration** menu to open the Power Management configuration dialog.

The power management dialog appears as follows.



The **Continuous Wake Mode** section specifies if the SOLARPack 410 stays in the continuous power mode at all times.

The following parameters can be configured for this mode.

- **Always Stay Awake** specifies if the flow computer should always stay awake. Valid values are Yes and No. The default value is No.
- **Radio Power** selects if the SCADA radio is powered. Valid values are ON or OFF. The default value is ON.
- ***Bluetooth* Power** selects if the *Bluetooth* radio is powered. Valid values are ON or OFF. The default value is ON.
- **Display** selects if the display is powered. Valid values are ON or OFF. The default value is ON.
- **Display Backlight** selects if the display backlight is powered. Valid values are ON or OFF. The default value is ON. This control is set to OFF when the display control is set to OFF.

The **Enable Input Activation** section specifies what happens when the enable input is activated. Activating the enable input places the SOLARPack 410 in the continuous power mode. A power off

timer starts when entering continuous power mode. The flow computer remains in this mode until the power off timer expires, then enters the power saving mode.

The following parameters can be configured for this mode. These controls are disabled when the controller is in the continuous wake mode.

- **Stay Awake For** specifies the number of minutes until power off. Valid values are 1 to 240. The default value is 10 minutes.
- **Radio Power** selects if the SCADA radio is powered. Valid values are ON or OFF. The default value is OFF.
- **Bluetooth Power** selects if the Bluetooth radio is powered. Valid values are ON or OFF. The default value is ON.
- **Display** selects if the display is powered. Valid values are ON or OFF. The default value is ON.
- **Display Backlight** selects if the display backlight is powered. Valid values are ON or OFF. The default value is OFF. This control is set to ON when the display control is set to ON.

The **Scheduled Wake Mode** section specifies when the flow computer should wake up. The flow computer stays awake for a fixed period of time in this mode. The controller is in the continuous power mode for the specified duration at the specified times, then it enters the power saving mode.

The following parameters can be configured for this mode. These controls are disabled when the controller is in the continuous wake mode.

Times to Wake lists the times at which the flow computer should wake. Up to 24 times can be added. The default value is an empty list.

Stay Awake For specifies the number of minutes until power off. Valid values are 1 to 240. The default value is 20 minutes.

Radio Power selects if the SCADA radio is powered. Valid values are ON or OFF. The default value is OFF.

***Bluetooth* Power** selects if the *Bluetooth* radio is powered. Valid values are ON or OFF. The default value is OFF.

Display selects if the display is powered. Valid values are ON or OFF. The default value is OFF.

Display Backlight selects if the display backlight is powered. Valid values are ON or OFF. The default value is OFF This control is set to ON when the display control is set to ON.

6.3 Bluetooth Communication

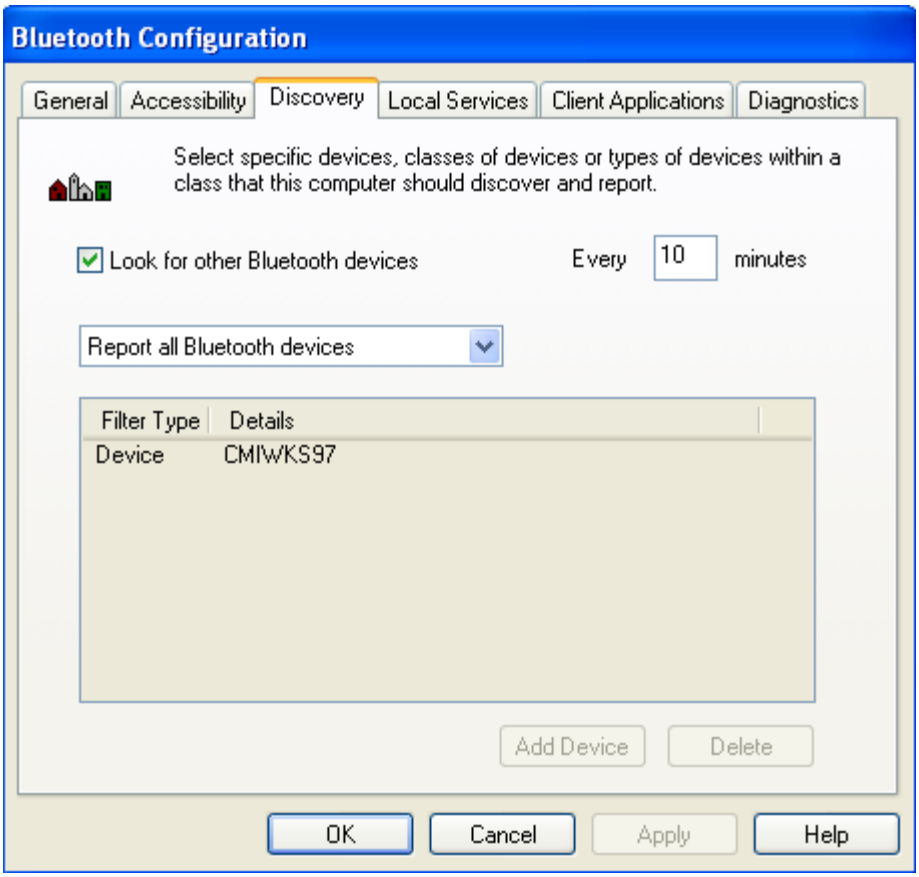
The SOLARPack 410 is designed to use a Bluetooth connection as the primary method for communication between the SOLARPack 410 and a laptop running RealFLO.

6.3.1 Configure Laptop Bluetooth Connection

If your laptop or PC has an internal *Bluetooth* adapter you can use it to establish a *Bluetooth* connection with the SOLARPack 410. Refer to your user manual for details on establishing a *Bluetooth* connection.

Note	If the SOLARPack 410 is used with a laptop using a built-in class 2 *Bluetooth* device, the range will be limited by the class 2 device (approximately 3m or 10 ft.)

The internal *Bluetooth* may not be set up for automatic discovery. This needs to be enabled in your configuration software. An example of the correct settings is shown in the following picture.



7 SOLARPack 410 Modbus Database Registers

SOLARPack 410 inputs are mapped to the fixed database registers. This permits using these registers with Process I/O in RealFLO, and polling the registers from a host.

The following registers are for the SOLARPack 410.

Primary Register	Type	Read/ Write	Parameter
40384-40385	Long Integer	R	Counter
40386	Integer	R	Low battery (0=normal, 1=low)
40387	Integer	R	Battery status (see below)
40388	Integer	R	Alarm status (see below)
40389	Integer	R	Charger configuration
40390	Integer	R	RAM battery voltage in millivolts
40391	Integer	R	Battery Current in milliamps
40392 – 40394			Reserved
40395 - 40396	floating-point	R	Board temperature in degrees C
40397	integer	R	Battery Voltage Input in millivolts

7.1 Battery Status

The battery status register reports the following states using bits in the Battery Status word.

Status	Value	Description
Normal	0	The battery is being discharged. No faults exist.
Fault	1	Battery voltage is less than 6V, or the battery is open circuit.
Under Voltage	2	System voltage has fallen to 10.5V or lower.
Battery Test	3	Before charging at high current rates, the device performs a number of tests on the battery to determine if it is healthy and can accept a charge without excessive hydrogen gassing. These tests cannot be performed unless the solar panel is sufficiently illuminated to generate charging current. Therefore, once entered, the battery test phase will continue until the solar panel can deliver charge current AND the battery passes all tests. If the battery fails the tests, this phase will continue indefinitely. Provided that the solar panel can deliver charge current, the battery will be charged at 50mA during this phase. A battery is judged to be healthy if its voltage measures at least 11.2V
Bulk Charging	4	The battery is being charged at the maximum current delivery ability of the solar panel. The maximum voltage on the battery is limited to the voltage specified by the Charge Voltage switch.
Float charging	5	The battery is fully charged and is being maintained at the float voltage specified by the Float Voltage switch.
Calibration	6	The measurement inputs are being calibrated.

7.2 Alarm Status

The charger status register reports alarms using bits in the alarm status word.

Status	Bit	Description
Faulty Temperature Sensor	0	0 = no alarm 1 = faulty temperature sensor Charging voltage is precisely regulated and adjusted according to temperature. Failure of this sensor can cause over-charging, hydrogen gassing, and permanent damage to the battery. Once the temperature sensor responds correctly, this alarm will clear. If the temperature sensor fails during operation, the device will remember the last valid temperature provided by the sensor. If the temperature sensor is disconnected or faulty at reset, the device will use 68F/20C as the default temperature. Sustained operation with a missing or faulty temperature sensor should be avoided, especially at high ambient temperatures.

8 Power Consumption and Autonomy

The autonomy of a SOLARPack 410 system is a function of several factors. These are:

- Size of the solar panel.
- Solar panel orientation and location. The available power from the solar panel will vary considerably throughout the seasons and in different geographic locations.
- Operating temperature will affect the solar panel efficiency and battery performance.
- Battery size and type. Some batteries work better at high or lower temperatures.
- Remote sensor version has higher power consumption than the internal sensor version.

The following are configurable in RealFLO and can be used to keep the power consumption of the SOLARPack 410 low and increase the autonomy.

- Power consumption of the integrated or user installed radio and amount of time the radio is on.
- Amount of time the *Bluetooth* communications is enabled.
- Amount of time the LCD display is enabled.
- Amount of time the LCD display is backlit. Backlighting the display has high power consumption.

Control Microsystems can provide tools and configuration examples to help you determine the autonomy, battery size and solar panel size in your particular application. Contact Control Microsystems Technical Support and ask for the SOLARPack 410 Autonomy Calculator.

9 Maintenance and Calibration

The SOLARPack 410 requires no routine maintenance. If the SOLARPack is not functioning correctly, contact Control Microsystems Technical Support for more information.

The SOLARPack 410 is calibrated at the factory and does not require periodic calibration. Calibration may be necessary if the module has been repaired as a result of damage. Calibration is done at the factory.

10 Specifications

10.1 General

I/O Terminations	Screw terminations 12 to 24 AWG 20A contacts
Dimensions **Internal Sensor Version**	All dimensions include mounting tabs, latches and low profile sensor. 10.94 inch (278 mm) wide 18.62 inch (473 mm) high 10.55 inch (268 mm) deep
Dimensions **Remote Sensor Version**	All dimensions include mounting tabs and latches. 10.94 inch (278 mm) wide 15.88 inch (403 mm) high 10.55 inch (268 mm) deep
Weight	Internal sensor Version: 16 lb. (7.3 kg.) Remote Sensor Version: 9 lb. (4.1 kg.) 31A-hr. battery: 23.4 lb. (10.6 kg.)
Mounting	2 in. pipe mount Wall mount Uni-strut mounting Sensor mounting (Internal Sensor version only)
Packaging	Type 3RX Aluminum with powder coat paint.
Environment	SOLARPack not including the display and battery 5% RH to 95% RH, non-condensing –40°C to 55°C (–40°F to 131°F) Display: –20°C to 55°C (–4°F to 131°F) Long term storage and operation outside of these limits is not recommended.

10.2 Controller

Processors	32-bit ARM microcontroller, 32MHz clock integrated watchdog timer Two microcontroller co-processors.
Memory	4MBytes CMOS RAM 16MBytes Flash ROM 1kBytes EEPROM
Non-volatile RAM	CMOS RAM with lithium battery retains contents for 2 years with no power
Clock calendar	±1 minute/month at 25°C +1/-3 minutes/month 0 to 50°C

10.3 Communications

COM1 Internal Sensor Version	Direct to sensor interface

COM1 Remote Transmitter Version	RS-485 2-wire half duplex. 5100Ω bias resistors
COM2	Defaults to optional internal Spread Spectrum Radio. RJ-45 modular jack (RS-232) is enabled when device is detected on the jack. TxD and RxD implemented. RS-232 compatible serial port (CMOS) RS-232 –maximum 10 ft (3 m)
COM3	Integrated *Bluetooth* Communication.
Baud Rates	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200
Parity	none, even, or odd
Word Length	7 or 8 bits
Stop Bits	1 or 2 bits
Transient Protection	COM1 (External), COM2 (External): 2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
Isolation	Common ground return connected to negative side of Vin power input.
Protocols	COM1: Proprietary COM2 and COM3: TeleBUS (compatible with Modbus RTU and Modbus ASCII)
Protocol Modes	COM2 and COM3: Slave, master, master/slave

10.4 Internal Spread Spectrum Radio Communications

General	Optional FreeWave FGR09CSU Industrial 900MHz. radio. Frequency Hopping Spread Spectrum
FGR09CSU	GFSK modulation. 902 to 928 MHz. 5mW to 1W transmit power -108dBm receive sensitivity 60 miles line of sight User selectable hopping channels, patterns and bands.
Installation	Fully integrated including serial communication, power supplies and RF (antenna) output with Polyphaser surge protection and N female connection.
Options	Enclosure accommodates mounting of MDS TransNET 900. Contact Control Microsystems for availability of other internal radios.

10.5 Bluetooth Communications

General	Radio modem compatible with Bluetooth® enabled devices. Frequency Hopping Spread Spectrum. Encryption, PIN identification and Error Correction.

Frequency	2.402 to 2.48 GHz.
Distance	Class 1. Up to 100m (330 ft.) line up sight.
Antenna	Integrated chip antenna

10.6 Pressure Transmitter

	Differential Pressure Ranges	**Absolute Pressure Ranges**
U	0.5 to 30 inH_2O (0.12 to 7.5 kPa)	1 to 100 psi (0.007 to 0.7 MPa)
V	2 to 200 inH_2O (0.50 to 50 kPa)	3 to 300 psi (0.021 to 2.1 MPa)
W	10 to 840 inH_2O (2.5 to 210 kPa)	3 to 300 psi (0.021 to 2.1 MPa)
X	2 to 200 inH_2O (0.50 to 50 kPa)	30 to 1500 psi (0.21 to 10 MPa)
Z	3 to 300 inH_2O (0.75 to 75 kPa)	30 to 1500 psi (0.21 to 10 MPa)
Y	10 to 840 inH_2O (2.5 to 210 kPa))	30 to 1500 psi (0.21 to 10 MPa)
M	2 to 200 inH_2O (0.50 to 50 kPa)	30 to 3000 psi (0.21 to 21 MPa)
P	3 to 300 inH_2O (0.75 to 75 kPa)	30 to 3000 psi (0.21 to 21 MPa)
R	10 to 840 inH_2O (2.5 to 210 kPa)	30 to 3000 psi (0.21 to 21 MPa)
Q	2 to 200 inH_2O (0.50 to 50 kPa)	30 to 5300 psi (0.21 to 36.5 MPa)
S	3 to 300 inH_2O (0.75 to 75 kPa)	30 to 5300 psi (0.21 to 36.5 MPa)
T	10 to 840 inH_2O (2.5 to 210 kPa)	30 to 5300 psi (0.21 to 36.5 MPa)

	Maximum Static Pressure, Working Pressure (MWP)	**Maximum Overrange**
U	100 psi (0.7 MPa)	150 psi (1.0 MPa)
V	300 psi (2.1 MPa)	450 psi (3.1 MPa)
W	300 psi (2.1 MPa)	450 psi (3.1 MPa)
X	1500 psi (10 MPa)	2250 psi (15 MPa)
Z	1500 psi (10 MPa)	2250 psi (15 MPa)
Y	1500 psi (10 MPa)	2250 psi (15 MPa)
M	3000 psi (21 MPa)	4500 psi (30 MPa)
P	3000 psi (21 MPa)	4500 psi (30 MPa)
R	3000 psi (21 MPa)	4500 psi (30 MPa)
Q	5300 psi (36.5 MPa)	7420 psi (51.2 MPa)
S	5300 psi (36.5 MPa)	7420 psi (51.2 MPa)
T	5300 psi (36.5 MPa)	7420 psi (51.2 MPa)

Performance Specifications	Zero-Based Calibrations; Stainless Steel Sensor with Silicone Fluid; Under Reference Operating Conditions unless otherwise specified; URL = Upper Range Limit and Span = Calibrated Span
Accuracy	Differential pressure ranges 200 to 840 inH_2O ±0.05% of Span for Spans ≥10% of URL Differential pressure range 30 inH_2O ±0.10% of Span for Spans ≥10% of URL Absolute pressure ranges 30 inH_2O ±0.05% of Span for Spans ≥10% of URL
Stability	Long-Term Drift less than ±0.05% of URL per year over a 5-year period.
RFI Effect	The output error is less than 0.1% of span for radio frequencies in the range of 27 to 1000 MHz and field

	intensity of 30 V/m when properly installed.	
Static Pressure Effect on Differential Pressure		For a 0.7 MPa, 100 psi, change in static pressure. Span shift is ±0.01% of reading. The zero shift in % of URL is:
	U	±0.050
	V	±0.007
	W	±0.002
	X	±0.010
	Z	±0.007
	Y	±0.004
	M	±0.010
	P	±0.007
	R	±0.004
	Q	±0.010
	S	±0.007
	T	±0.004
Position Effect	Any zero effect caused by mounting position can be eliminated by rezeroing. There is no span effect.	
Ambient Temperature Effect	Total effect for a 28°C (50°F) change within Normal Operating Condition Limits. ±(0.03% URL + 0.06% Reading); Differential pressure for 30 inH_2O is ±(0.18% URL + 0.025% Reading). Absolute pressures for 3000psi ranges the effect is ±(0.02% URL +0.06% Reading). Absolute pressures for 5300 psi ranges effect is ±(0.15% URL +0.06% Reading).	

10.7 Temperature Measurement

RTD accuracy	±0.28°C (±0.5°F) This does not include RTD uncertainties, which are additive.
RTD type	100 ohm platinum 0.385 ohms/°C 3 and 4 wire. Auto detection and compensation.

10.8 Counter Input

Type	Jumper link selectable for use with turbine meter amplifiers or dry contact closure. For use with low voltage, turbine meter outputs.
Turbine Meter Sensitivity	Minimum input 30mVp-p at 5-50Hz. Minimum input 150mVp-p at 150Hz. Minimum input 650mVp-p at 5kHz. Minimum input 750mVp-p at 10kHz. Maximum input 4Vp-p using internal amplifier.
Dry contact Input	Maximum input 10Vp-p without internal amplifier. Maximum frequency 10KHz. Wetting current typically 1.2mA at system voltage.

	Contact closure to ground is ON. Open input is OFF.
Transient Protection	2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
Isolation	Common ground return connected to Chassis Ground.

10.9 Battery Charger

Solar Panel	Power - 32W max. Open circuit voltage - 25V max. Short circuit current - 2.0A max.
Regulation	Shunt regulation Temperature compensated.
Battery Type	DIP switch selectable for VRLA (Valve Regulated Lead Acid) or Cyclon Pure Lead VLRA types include: Gelled Electrolyte (Gel) 13.8V charge, 13.5V float Absorbed Glass Mat (AGM) 14.4V charge, 13.8V float
Charge voltage	DIP switch selectable for 14.4V or 13.8V (VRLA only)
Float voltage	DIP switch selectable for 13.8V or 13.5V (VRLA only)
Charging states	Battery test Charge (Bulk followed by absorption) Float
Display	Display indication of changing states.

10.10 LEDs and Switch

LEDs	Tx (Com2), Rx (Com2), Run, Status, Force
Switch	LED disable, Wake up and Cold Boot
LED disable	Switch enables/disables LEDs. LEDs disabled after 60 sec. time out.

10.11 LCD Display

Type	LCD with configurable backlighting
Size	2 lines X 20 characters

10.12 Outputs

Gas Sampler	Quantity - 1 Type - Selectable as Sourcing or Sinking Voltage - 13.5V nominal System Voltage used when sourcing. Current - 2A continuous with short circuit protection. Configurable Pulse Width - 0.1s to 5.0s in 0.1s increments. 1.0s default.
External Radio Power	Quantity - 1 Type - Sourcing, switched Voltage - 13.5V nominal, System Voltage Current - 2A continuous with short circuit protection.
External Transmitter	Quantity - 1

Power	Type - Sourcing, switched Voltage - 13.5V nominal, System Voltage Current - 0.2A continuous with short circuit protection.

10.13 Power supplies and power consumption

System Voltage	13.5V nominal
Under voltage lockout	System Off - 10.0V (typical) System On - 11.5V (typical)
Power consumption	Internal sensor interface, gas flow calculations, display for 10 minutes per week and Bluetooth communications for 10 minutes per week - 108mW Remote sensor interface, gas flow calculations, display for 10 minutes per week and Bluetooth communications for 10 minutes per week - 150mW
	Optional integrated FreeWave radio receiving 90 minutes per day - Add 44mW.
	Optional integrated FreeWave radio receiving 100% of the time - Add 700mW.
	Optional integrated FreeWave radio transmitting 10 minutes per day - Add 9mW.
	Gas Sampler with one 2A pulse, 0.1seconds duration, 15 minute period - Add 3mW
	Dry contact wetting current not included in above.

10.14 Approvals and Certifications

Safety	Electrical Equipment for Use in Class I, Division 2 Groups A, B, C and D Hazardous Locations. C(CSA)us Temperature Code T4.
Digital Emissions	FCC 47 CFR Part 15, Subpart B, Class A Verification EN61000-6-4: 2001 Electromagnetic Compatibility Generic Emission Standard Part 6-4: Industrial Environment.
Immunity	EN61000-6-2: 2001 Electromagnetic Compatibility Generic Standards Part 6-2: Immunity for Industrial Environments
Declaration	This product conforms to the above Emissions and Immunity Standards and therefore conforms with the requirements of Council Directive 89/336/EEC (as amended) relating to electromagnetic compatibility and is eligible to bear the CE mark. The Low Voltage Directive is not applicable to this product.